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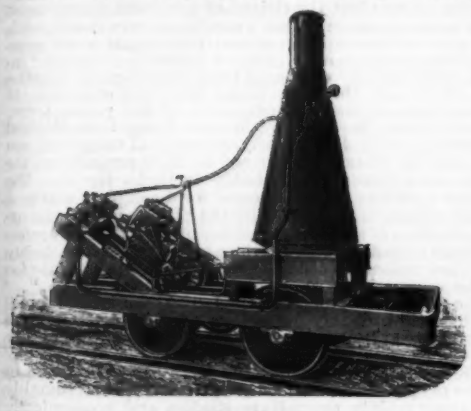
OLD LOCOMOTIVES AT THE COLUMBIAN EXPOSITION.

We publish engravings of several of these, which are interesting, says *Engineering*, not only as early examples of mechanism, but also as marking stages in the development of the American type of locomotive. The earliest of the locomotives shown in our illustrations is the James, built in 1832. The name of the builder was William T. James, and this was the second turned out by him. The first comprised a rudimentary form of link motion, which was further developed in this case until it contained in essential particulars the construction commonly attributed to Stephenson, and really due to Howe, who worked it out independently thirteen years later than James. The engine had cylinders 10 in. in diameter by 10 in. stroke, set upon a wooden frame inclined at an angle of 30 degrees to the horizontal. Four fixed eccentrics, with shafting links, operated the slide valves, the reverse shafts and hangers controlling the position of the links. A weight was fixed on the reverse lever to retain the links in position at either end of the travel, but there was no means of fixing them in an intermediate position. This locomotive was run on the Baltimore and Ohio road for two or three years, and then returned to the Harlem road, when it soon after exploded.

The first appearance of the bogie, or swiveling truck, was on the Experiment, built in 1832 by John B. Jervis. This engine had a truck connected to it by a strong pin, and working on anti-friction rollers. It is stated that on a level straight road the engine had covered a mile in 50 seconds, running with great ease and steadiness. In the following year Robert Stephenson built the Davy Crockett, from Jervis' plans, for the Saratoga Railroad, this also having a leading truck.

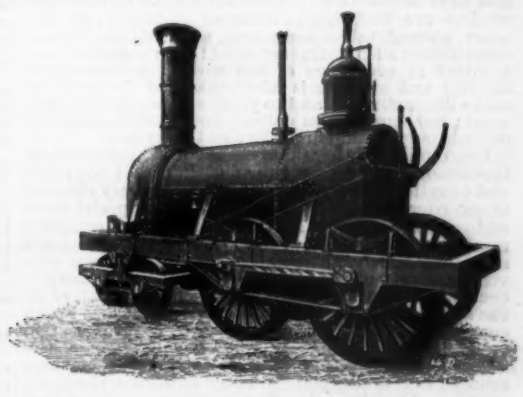
The next four years saw a great advance in locomotive design in America. In 1836 Henry R. Campbell patented a design having coupled driving axles, one before and one behind the firebox, and a four-wheeled truck. The following year he built the engine shown as the Campbell, which may be regarded as the first American-type locomotive. In the same year (1837), the Lafayette was built in America by Norris. In this there were exhibited several of the features introduced and advocated by Mr. Edward Bury, afterward of the firm of Bury, Curtis & Kennedy, and locomotive superintendent of the London and Birmingham Railway. These include the bar frame and the circular firebox with the dome-shaped top. Eight engines of this type were built in America to work the Lickey incline on the Birmingham and Gloucester Railway. They had cylinders 10½ in. in diameter by 18 in. stroke, with driving wheels 4 ft. in diameter, their weight being 9½ tons. The usual performance on the Lickey incline had been the haulage of 33 tons at 12 to 15 miles an hour. One of the American engines lent to the Grand Junction Railway drew 100 to 120 tons on an incline of 1 in 33, at 14 to 22½ miles an hour.

The Mazeppa shows a locomotive, originally built as a "grasshopper," and converted to a "crab" in 1837. The cylinders were changed from the vertical to horizontal, the walking beams and connecting rods being removed. The cylinders were placed by Ross Winans at the rear end of the frame, suggesting the motion of a crab, which was in contradiction of the name Mazeppa. This engine has a record of over fifty years' service. Some years later (1844), the Buffalo, a modified form of "crab," known as a "mud digger," was brought out by Ross Winans. This was the first engine in the world having four coupled axles. It was, to a great extent, a makeshift construction, and in subsequent engines the vertical boiler was replaced by one of the horizontal type.



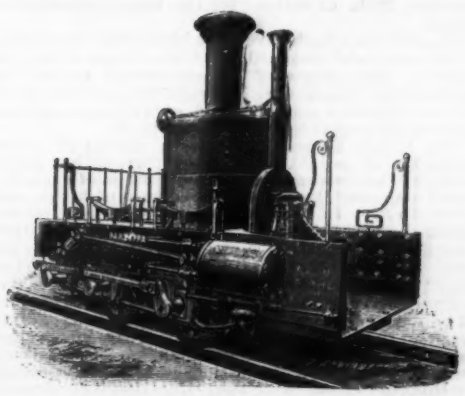
THE JAMES, 1832.

THE EXPERIMENT, 1832.

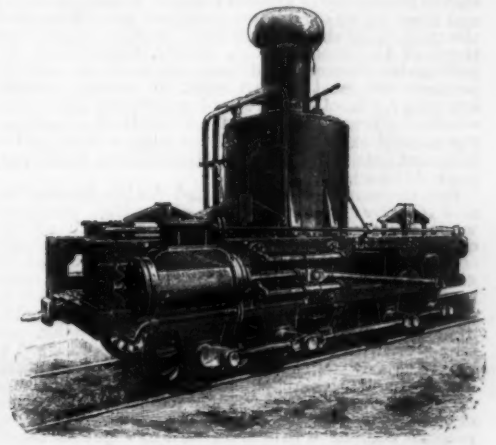


THE CAMPBELL, 1837.

THE LAFAYETTE, 1837.



THE MAZEPPA, 1837.



THE BUFFALO, 1844.

EARLY AMERICAN LOCOMOTIVES AT THE WORLD'S COLUMBIAN EXPOSITION.

THE MOTIVE POWER WILL STAY AT THE HEAD OF THE TRAIN.

It is somewhat amusing to read the editorials and comments upon the tug of war which occurred on railroad day at the Fair, between an electric motor and a steam locomotive. The steam locomotive came out victor, not because it was operated by steam, but simply because it weighed more than its competitor. The locomotive was a Baltimore and Ohio switcher, weighing 65,800 lb. on the drivers, and the electric locomotive, made by the General Electric Company, weighed about 60,000 lb. As both engines could slip their wheels, the result could only go one way—the heavier one would pull the lighter—but the incident has afforded a text for many editorials eulogizing the steam locomotive, and prophesying that it will be many a long day before it is superseded by the electric locomotive. These prophecies may be true, and doubtless are, but the tug of war has no bearing on the matter.

One of the editorials referred to appeared in the pages of *Locomotive Engineering*, in which the following was stated:

It appears to us that an electric locomotive is a mistake, anyhow. Those who work on this line of invention attempt to perpetuate the worst feature of a steam locomotive, which is the big percentage of dead weight added to the train. To exert a starting power of 20,000 lb. on the drawbar a locomotive must weigh over 50 tons. . . . When electricity is employed, the wheels of the cars can easily be made the drivers, as in the case of street cars. A train operated in this way would not have a heavy locomotive to be lifted up every hill and to add nearly as much weight as the remainder of the vehicles. If ever electricity should come into use for the operating of surface roads, we anticipate that every car will carry its own means of applying power. The prospects of seeing electric locomotives in the front of trains are not good.

These remarks are in line with an argument that has been advanced many times, but which is manifestly absurd. It only requires a little calculation and a familiarity with railroad business to know that the only feasible way to employ the present electric motor on surface railroads would be to place it at the head of the train. Take, for instance the freight traffic of the country. Assume that we have a train of forty cars requiring at its head a steam locomotive of 800 horse power, weighing 50 tons, and with its tender 80 tons. We have 20 horse power available for each car, excluding the engine itself, and if each freight car was fitted with a 20 horse power electric motor, provided with heavy axles, wheels, gearing and appurtenances, it would require fully 3,000 lb. additional weight per car. This means 60 tons weight embodied in motive power in the train, and is actually more than would be required if concentrated in one motor at the head of the train, and is more than the weight of the steam locomotive, exclusive of the tender. So the idea of saving weight by such methods is erroneous, for putting motors on each car would not enable us to lighten the construction of the cars in any respect, and, as has been shown, the total weight added to the train would be more than if concentrated at the head of it.

Then small motors cost much more per horse power than large ones, and are less efficient. Another fact which is apparently given no consideration is that the average freight car makes about 24 miles per day, or say 8,500 miles per year, while the steam locomotives

can easily make 50,000 miles a year; therefore, to put motors under the cars would not only involve a larger expenditure of capital per horse power, and a lower efficiency, but would result in getting only about one-sixth as much mileage from the motive power. Then there is all the complication arising from operating all the motors from the front of the train, to say nothing of the fact that repairs would have to be made upon 40 machines instead of 1, and must invariably be more expensive. The same argument we have here employed is applicable to passenger equipment.

Just think of railroads choosing to buy and maintain over 1,100,000 motors for freight service and nearly 40,000 for passenger service when 35,000 larger ones would do the whole business! If ever used at all, the motors will go to the head of the train.—*Railway Master Mechanic.*

TECHNOLOGICAL SCHOOLS: THEIR PURPOSE AND ITS ACCOMPLISHMENT.*

By ROBERT H. THURSTON, Director of Sibley College, Cornell University.

THE purpose of any institution of learning, whether of high or of low degree, is, if I understand it aright, to contribute a defined amount to the education of the boy or girl, man or woman, who may enter its doors. It should have a prescribed plane and area of work; it should have a settled method; it should be expected to apply this method, within its own field, to the presentation, by the best of known processes, of the most important facts and principles of those branches of learning which constitute its special province.

The education of the boy or the girl, of the man or the woman, may be said to consist of so much of knowledge of the sciences, the literatures, and the arts as the individual finds it practicable to obtain, by the application of time and thought and study, in hours set apart from those of toil and compulsory occupation. It purpose is twofold: to so exercise the mental faculties and powers as to confer upon the mind capacity for easy and extensive gain of both culture and knowledge; and to endow it with learning and wisdom—for those are not the same. Culture and wisdom are the highest fruits of education, grafted upon natural talent and power, and, well developed, constituting such character as has been respected and admired in every age of the world. Knowledge is needful and learning is admirable and desirable to make life successful and to yield substance for enjoyment; but, apart from culture and wisdom, they fail of their purpose and life falls short of its aim.

From university to primary school and kindergarten, throughout the whole range of human knowledge and of systematically given instruction, every element of the educational structure has its own special place and purpose, contributing to the final and complete result; but the plan and the scope of these elements may differ widely. The university, if it be a real university, must present to its students the opportunity to become acquainted with the elements, at least, of all the sciences, all the literatures, and all the arts which contemporary life and modern civilization rest upon or imply familiarity with. The primary school usually only makes a beginning, as do all the elementary schools, in teaching the child how to begin to learn by study, and furnishes the first necessary tools for that trade. The kindergarten teaches the child how to learn by observation and direct experiment; it is the child's laboratory of applied science. But every school and every college and all universities should combine the methods of the conventional primary school with those of the kindergarten. Study, observation, experimental processes and methods, must all unite to produce the most perfect work in primary school, secondary school, college and university alike, and whether giving the elements and tools of education, the manual exercise required for higher work, or the facts and data and principles of the sciences, be the purpose of the school.

But the man must be educated for his coming life, and the lives of men differ. Education, therefore, while having the same general object with all, the cultivation of the powers of the individual and the communication of knowledge and culture, must be given somewhat different directions, and must cover somewhat different fields for different men, if it is to do its most perfect work on every individual. The man who is independent of compulsory labor, and who may, with reasonable confidence, look forward to a life of his own choice and making, will desire culture, learning and accomplishments. The youth growing up in the home of the working man, without fortune or reasonable expectation of ever securing even a competence, compelled to look forward to a life of constant and perhaps arduous labor, subject to a competition from neighbors or often from working men thousands of miles away, needs, first of all, that knowledge and training which will enable him to hold his own and make sure of subsistence and freedom from privation for his family and himself. The average citizen, with such capital as a generation or two of industry and skill may have laid aside for him, free to give time and money for such education as can be given him before the approach of manhood brings with it the cares and responsibilities of his later working life, seeks, if he be wise, first insurance against failure in his vocation, next such culture and such knowledge as he may gain therewith, as a part of or in connection with his preparation for his life's work. Finally, the well-to-do citizen possessing competence, but not wealth, seeks for his son or his daughter a scientific training for a profession, and a culture befitting his station in life; the first the essential, the last the most desired. Every citizen asks the privilege and claims the right to secure as much of necessary preparation for the future of his life and as much of that culture which is life as time, means, and natural capacity may permit him to fairly demand.

It was long ago recognized by statesmen and men of mind that one of the first duties of the State is to make sure a fitting education of the people of the State by providing elementary schools for all who choose to avail themselves of them.

It was also early admitted that a system of useful elementary education presupposes higher institutions of learning, in which the teachers of those schools may be prepared for their work and in which all the learning of the time may be preserved and given fullest opportunity for extension and expansion. It is now well understood by all intelligent men that the state must, to insure the highest prosperity and enlightenment of its people, directly or indirectly, by legislation or through the stimulated or spontaneous liberality of its wealthy men, superpose secondary schools upon primary, and colleges upon the schools, and must place universities at the apex of the structure. The great States of the West have their State universities; the old States of the East have their Harvard and their Yale and Brown and Amherst and Williams, at once monuments to great and statesmanlike citizens among the wealthy classes and capsheaves of their educational systems. No State so poor and sparsely populated, no statesman so weak and narrow, as to refuse to build to the very peak of the pyramid. In fact, it is often asserted that the true statesman, like Washington and Jefferson, Madison and the Adamses, makes the university the foundation, the secondary schools the body and the primary schools the supported apex of the system; the whole resting safely and firmly, if properly constructed, upon a solid and broad foundation of deepest wisdom and greatest learning.

The State must build foundation as well as superstructure and every part of each, if completeness and solidity and permanence are to be made sure. Only the State, it seems to me, can maintain permanently, certainly, and in efficient, continuous, and steady operation, any single element of this organism; and only the State can construct and maintain it in symmetry and completeness and build solidly and durably the whole great structure. Private contributions to this purpose and object are too uncertain, irregular in amount, and sporadic in time and distribution, to give that regularity of income or that certainty of any income at all which is an essential element of steady and productive work. Regularity and sufficiency of income, assured by a fixed taxation, as illustrated in our Western States in many instances, is probably the best insurance of life, of continuous growth, and of uninterrupted usefulness of the educational system. Private endowments are usually either unequal to their purpose at the start, or are promptly overburdened, if the enterprise is successful, and almost never permanently reliable and regularly useful. At the present time, also, the continuously decreasing rate of interest on good securities and the constantly increasing difficulty of finding safe investments, make the duties of the committees on finance of our endowed institutions continually more and more arduous and unproductive. The steady fall from the seven per cent. of a few years ago to the six per cent. of later years, and to the five per cent. and less of to-day, and the resulting anxieties and financial difficulties, simply indicate the beginning of a continuous reduction in value of invested funds, and the fact that the time must come—perhaps soon—when returns on invested capital will become so small as to make it hardly wise to rely on such sources of income, and such as to compel the use of the principal in such cases, and reliance upon continual additions of capital through the liberality of capitalists to whom the same cause makes it less and less desirable to hold a surplus. But every institution doing good work will very possibly find it necessary to its own existence and permanent usefulness to become in some way incorporated into the system of the State, or, as the only alternative, rely mainly on tuition fees exacted from its own students, thus competing at a great disadvantage with state-supported institutions charging little or nothing for the same grade of education.

The following facts give some idea of the magnitude of the task to be assumed and of the impracticability of securing permanence of an educational system by private effort; even were it possible that private liberality and private activity could give the system form and coherent and symmetrical growth:*

The United States constitute a nation of about 65,000,000 of people. Of these, three-fifths, about 40,000,000, are minors, and a large fraction of them demand and need instruction in schools of higher and lower degree. In their education, 300,000 teachers are engaged in 200,000 schools, and about $100,000,000 per annum are paid for the work. The States usually expend about $25 per capita, and some of the cities about $35, for elementary instruction alone. The federal government has given over 150,000,000 of acres of public lands to this object, and the States have often assigned their first and largest apportionments of their own public lands to their departments of education. In some cases, single institutions have greatly profited by this policy; but, as a rule, education is conducted, in the higher departments, with a most frugal hand.

Private liberality has as yet done more for individual endowments, generally, than the public. For example, in New York, the State University—Cornell—receives as the share of the State under the Morrill act about $20,000 a year from the half million or less obtained by sale of land scrip; it receives from the Cornell endowment, which was produced by the discreet holding and sale of the lands obtained on the same scrip bought by Ezra Cornell and given to the university, over $300,000 per annum from the $5,000,000 or more thus privately given it; and it has still enough land for sale to make about 500 good farms. Harvard, Columbia, Yale, and Princeton, and Johns Hopkins have larger incomes from private endowments than have the institutions supported by the States.

The governments of Europe are wiser and more liberal than our own States. Prussia has erected at Charlottenburg the grandest technical institution in the world, at a cost of about $4,000,000. Saxony has erected a whole system of trade and polytechnic schools and Zurich has invested, safely and profitably, some millions in her great university, of which the laboratories alone have cost about a half million dollars. With a taxed valuation of $6,500,000,000 the State of New York has contributed—and only within the year—just $50,000 to its university, under the shadow of the millions given it by its private benefactors. Michigan has given about $2,000,000 to her university and technical schools; she also gives a regular tax levy of large amount. Wisconsin gives a half million in buildings and a tax levy of about $75,000 per annum. Minnesota has given to the same cause about $750,000 and a tax levy of about $50,000; California about $1,000,000 and a perpetual State tax of one-tenth of a mill, now yielding $100,000 a year; and other States, in a similar manner, are just beginning the work which has been going on in Europe for a century.

In fact, nearly every large and strong school, college and university famous for good work, and especially among the technical institutions, is coming to be state supported in greater or less degree. Some of the most successful and famous of all are exceptions to this rule; but whether this is likely to remain the fact a generation hence may be gravely doubted. Contributions to this noblest of philanthropic works will undoubtedly be larger and more numerous than now; but interest will probably fall to two per cent., or perhaps even lower, and a million of dollars will then do but little in the support of higher education.

Culture and scientific training for a practical man are the two purposes of all schemes of education of the individual citizen. But their order and extent, and their relative importance and magnitude, must depend upon the position in life of the individual, rather than upon his choice or their natural and logical sequence. The proper and logical order would be: first culture, then professional training; first the awakening and strengthening of the mind, then its application to the purposes of culture, then its practical employment in acquiring and practicing the chosen vocation, whether that of the engineer who builds, the artist who adorns, the man of letters who entertains and enlightens, the jurist who interprets the law, or the physician or the clergyman who ministers to bodies or to minds diseased, or even that of the man of leisure whose profession is that of the accomplished man of a society of culture. Every intelligent citizen desires for his children so much of culture as his time and means permit him to give them; his means determine to what extent he must abridge the culture studies and compulsorily antedate the best time for entrance upon the studies having practical application in the life of the bread winner. For people of wealth, twenty years of culture and five of professional study may be none too extensive a course; but the citizen of moderate means must at least terminate his son's studies at twenty-one, and, if he is to have a professional training, it must commence at sixteen or seventeen; while the so-called "industrial classes" must send their offspring out into the world to earn their own living while still children. It thus happens that the education of the people must, in the main, be such as will give them technological training, with, incidentally, so much of culture as can be offered without detriment to their preparation for the work that must probably be theirs for life. We have here the reason at once for a complete and perfect system of education by the State, and for the organization of special manual-training, trade, and professional schools. The conditions here discussed probably do not indicate a necessity for support by the State for the distinctively so-called "professional schools," of the as distinctively so-called "learned professions." They will probably be always overcrowded and well supported; unless, indeed, they should some time cease to be looked upon as specially desirable vocations by the most ambitious of young men. The education of the people of the State, by the State, will presumably include mainly the culture studies and economically important branches of technical education.

John Scott Russell thus defines technical education: "What I call technical education is that kind of training which will make the new generation of Englishmen excel the new generation of foreigners in this coming rivalry of race and nation. The English live in the midst of an energetic rivalry of competing nations. The aim of our national life should be to do the work of the world better, more ably, more honestly, more skillfully, and less wastefully than the skilled men of other countries. If we are less skilled or less honest than others, we are beaten in the race of life. To the national welfare and success it is therefore necessary that the young race of men who are to do the work of England shall in his own special profession, occupation, trade or calling, know more thoroughly its fundamental principles, wield more adroitly its special weapons, be able to apply more skillfully its refined artifices and to achieve more quickly, perfectly and economically the aims of his life, whether it be commerce, manufactures, public works, agriculture, navigation or architecture."

The same remarks are true as applied to the United States; for the Atlantic Ocean has ceased to be, to any important extent, a wall of defense against foreign competition in the refined industries, those which give wealth to the worker and diversification of industries to the nation. Our school and college curricula have hitherto been—and are still, in fact—vastly too exclusively literary to meet the needs of the people and of the country. We have made hardly a beginning in the building of that great system of industrial training, supplementing education, which must, if we are to survive in the industrial rivalry of nations, soon be made to constitute an important and extensive division of the State and of the national educational structure.*

It is this aspect of the case which makes the introduction and perfection of technical education in our own country, and its development as a part of a State and national system, matters of supreme importance to the people and to the nation. Unless our people are at once more intelligent and better trained in their productive vocations than those of other nations, they must be content to settle to a lower level and there remain.

Technical education and technological schools thus constitute, for us, the most important of all current topics and subjects, in connection with educational work and development, in this country. The foundation of technical schools of all grades, from the kindergarten and the purely manual training schools, to the special trade schools and the higher schools of engineering, agriculture, architecture, and art, is the essential and pressing duty of the hour. Their organization and their incorporation into the great educational system of State and nation constitutes the grandest problem of the time, for educator, patriotic citizen, and statesman alike, and the questions: To what extent, and in what form, should our educa-

* Opening the discussion on technical education, World's Educational Congress, Chicago, July 26, 1893, President Francis A. Walker in the chair.

* Sibley College Reports.

* Technical Education. By the writer. Trans. Am. Soc. Mech. Engrs., 1883.

tional system include technical schools? How shall their distribution among the various vocations and professions be symmetrically effected? To what extent and in what manner should the State sustain them? and What are the deficiencies in number, curriculum, and method of the schools already established?—these questions are those of the hour. These constitute the great problems of the citizen, the educator, the legislator, and the statesman of our time. Such questions as these demand discussion and action, imperatively and continuously. They are more pressing and vital than those of tariff or currency, annexation of adjacent provinces or choice of gold or silver, iron or copper, for our coinage. Economical errors of the latter sort may isolate us from the rest of the world; but errors in the moral and intellectual, or the technical, training of the people, may make home life less satisfying.

The magnitude of the demand for technical instruction in the United States is greater than is usually supposed, and the real need—which vastly exceeds the demand—is far beyond the ordinary estimates of even the educator engaged in this special work. The writer has estimated that, were the United States, as a whole, to provide as liberally for the technical education of its people as do some of the provinces of France, and of Germany especially, there would be established:

Twenty technical universities, having in their schools of engineering and higher technique, 50 instructors and 500 pupils each.

Fifty trade schools and colleges, of 20 instructors and 300 students each.

Two thousand technical high schools, or manual training schools, of 10 instructors and 200 pupils each.

That is to say: There should be in the United States to-day, 1,000 university professors and instructors, and 10,000 students under their tuition, studying the highest branches of technical work; there should be 1,000 college professors and 15,000 pupils in trade schools, studying for superior positions in the arts; 20,000 teachers engaged in trade and manual training schools, instructing pupils, 400,000 in number, proposing to become skilled workmen. We have in this country 10,000,000 families, among which are at least 1,000,000 boys who should be in the latter class of schools. The cost of such education would be, per annum, about 50 cents per inhabitant additional to the present school tax, and in the shops of these schools less than $100 per student, and under $300 per annum per student, for total costs of higher education.

The actual number of schools of the highest class in this country—schools which are neither technical universities nor colleges, but, usually, either schools of restricted curricula, as engineering schools, or single and narrowly limited departments of colleges of general and mainly liberal learning—is about fifty. The number of real trade schools prepared to give proper training, scientific and practical, in any one trade, is unknown to statisticians, but they are exceedingly rare, and a thoroughly representative trade school, like hundreds of those scattered all over Europe, is unknown. We have, perhaps, a dozen good manual training schools in the larger cities; but we have no system of carefully organized, complete and well-sustained schools of either class, supported by nation, by State, by city, or by any form of public or private permanent systematic effort.

"Such is the intimidating comparison, also, of the condition of our country and the more enterprising and wisely governed countries of Europe. The latter have had two generations the start of us, and only the extraordinary natural advantages of our country and the more extraordinary general intelligence and enterprise of its citizens can possibly prevent this disadvantage under which we labor telling fatally against us in the course of time when the inevitable competition of the world shall affect us."*

On the other hand, every State is doing more and seeing more each year of the duty before it, and its importance, and the State universities and the independent colleges and schools are feeling their way constantly, though slowly, toward the solution of this tremendous problem. Our people are peculiarly well fitted to benefit by the opportunities which may be thus offered and to secure, in the interim, those kinds of training and those forms of knowledge which are the essential basis of the as yet incomplete technical system, and to compete with other nations at this disadvantage. The freedom of our institutions has engendered freedom of will and of intellectual action; and the free action of a thousand minds, untrammeled, though untrained, preserves us against dangerous rivalry from the better schooled but intellectually enslaved masses of the world outside. What will be the final outcome of the changes which are now slowly evolving an educational system in this country, and at the same time giving freedom and stimulus to European peoples, no one can predict. It can only be hoped that we may, in good time, have our own and an ample and efficient, "complete and perfect," system of education of our people for the life and the work of our people.

At the moment we have no system of suitable education of the nation, but we are making some progress toward the production of what is needed.

The character of our technical schools remains as yet as unsettled and various as the independent and far-separated points of origin permit. The State universities usually offer a few fairly well-defined courses in engineering and architecture and in the science and art of agriculture, and a few of the independent colleges stand beside them. The higher and lower literary colleges usually do but little in this field, and do that only under pressure and rarely well. The independent schools have as many standards of work as they have foundations. Some demand a good high school preparation; others only a few selected preparatory studies, and they, often, very elementary. Of the endowed schools some, as the Massachusetts Institute of Technology, are able to offer numerous courses in science and in the constructive work of applied science; others, as the Rensselaer Polytechnic and the Stevens Institute of Technology, elect to offer a single but strong course. Some approximate the technical university in their magnitude, extent and variety of work; the others, often denominating themselves engineering colleges, give a nondescript trade-school course. A few, like the Pratt Institute of Brooklyn, the Cooper Institute of New York, aid thousands of artisans; others give costly instruction to the wealthy few.

We need, in every State, a technical university, or a technical school side to a university, in which the highest possible grade of professional school shall be maintained, and for all the professions based upon learning. Law and engineering, medicine and architecture, theology and agriculture, all have their scientific basis, and their highest provinces and grandest fields lie where only the highest scientific training and widest knowledge can make them satisfactorily productive of good. Their courses should be precisely adapted to the presentation of all modern science, and the best of contemporary practice, to educated and well-prepared disciples, by the great leaders of each. That only can be rightly called a learned profession which demands of all its practitioners a thorough familiarity with the science, as well as with the art of that vocation. The planning of courses taught in professional schools should be capable of being very exactly defined and adjusted to the needs of the profession. The courses of the now more common mixed schools are less easily prescribed.

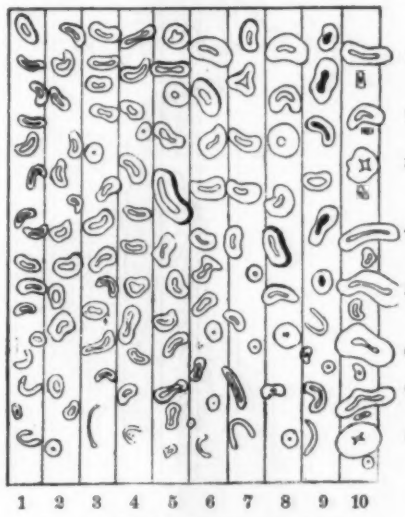
We need a trade school, or a technical college, embracing trade schools, in every large city in the country. We should have at least one in each of the smaller States, and from two to four in each of the larger and more densely populated States. The East needs weaving schools and schools of industrial art to serve as a foundation for her manufacturing system and her decorative work. The West is in especial need of similar schools to stimulate the introduction of manufactures among her agricultural districts. The South is in want of technical and trade schools to give her material to introduce into her cotton mills and metallurgical works. All parts of the United States need many such schools where at the moment one exists. Manual training schools are required wherever boys and girls are growing up to lives in which industry and skill are their only ways to competence or even to security from an old age of poverty and suffering. There should be not less than ten of these schools to every Congressional district in the country; and they should be open to the poorest, offering instruction in all the trades to the boys, in all the domestic arts to the girls.

(To be continued.)

* Sibley College Reports.

TEXTILE FIBERS.

SOME of the finest transverse sections of textile fibers we have ever seen have been recently shown to us by Mr. Abraham Flatters, Openshaw, near Manchester, who is now devoting his time to their preparation. The difficulties lying in the way of the preparer of such subjects as these may be appreciated when it is remembered that the diameter of a cotton fiber may vary from $\frac{1}{1818}$ of an inch at the tip to $\frac{1}{1000}$ at the base, and that the slices of many of the sections noticed herein are only the $\frac{1}{2000}$ of an inch in thickness.



SCALE: THOUSANDTHS OF AN INCH.

1. Tahiti. 2. Brown Egyptian. 3. Orleans. 4. Rough Peruvian. 5. Maceio. 6. Scinde. 7. Lagos. 8. China. 9. Red Peruvian. 10. Extremes in 1—8.

Of cotton fibers there is a goodly selection in transverse section, accompanied also by several stained slides of the entire fiber, showing the endochrome and the full length of the staple. We have examined them all under the 8mm. Zeiss apochromatic objective of 0·65 N. A., and also by the 4 mm. objective (0·95 N. A.) of the same series, using the 12 and 18 oculars, and we can say with confidence that we have never examined specimens of such perfect preparation. The wood cut will give an idea of Mr. Flatter's work.

The slides of Peruvian are exceedingly instructive to all those interested in textile matters; the "rough" is cut in slices of $\frac{1}{1818}$ to $\frac{1}{2000}$ of an inch in thickness, and the "smooth" is somewhat similar, the sections showing all positions from apex to base, and containing specimens of "dead" or "unripe" cotton; the *bete noire* of many a dyer. The "red" Peruvian is cut somewhat thicker, and shows the deposit of endochrome in the inner tube. The Egyptian brown is another slide of this character, not only showing endochrome within the inner tube, but in many sections the cellulose substance is also colored. "Gallini" also exhibits a light yellow endochrome; while the best slides to show the accretion of cellulose within the investing membrane are those of Orleans and Texas cotton, which are splendid sights under the Zeiss 2 mm. apochromatic of 1·30 N.A., and the 12 compensating ocular. To those who have only studied the structure of the cotton fiber under common objectives we advise a careful perusal of these remarks.

The slide of China cotton is a good specimen of well matured fiber, while the "Nankin shows a yellow endochrome more intensely than even Egyptian brown. Among the East India cottons we have "Rangoon," "Oomrawuttee" and "Hingunghat;" in African, "Lagos," while Brazilian is represented by "Ceara" and "Maceio," all these sections being cut to thicknesses varying from $\frac{1}{1000}$ to $\frac{1}{2000}$ of an inch.

There is a slide of "extra fine" Sea Island cotton, and also of "Tahiti," the latter being better than the former in point of excellence, from a microscopical point of view, showing as it does every point from "unripe" to fully matured, and a slight deposit of endochrome likewise. A section of 60's yarn and a section of bleached cotton stained with catechu concludes this series. In the latter the whole cellulose contents are stained brown, and the investing membrane made more apparent.

Among other textile fibers the transverse section of the stem of *Linum usitatissimum* shows the flax fibers *in situ*, while another slide exhibits the fibers when isolated. The stem of *Cannabis sativa* also shows the fibers *in situ*, the transverse section of the hemp fibers themselves making another slide in the series. The fibers of the *Corchorus capularis* (jute) have been very neatly sectioned, and exhibit great dissimilarity to the two former fibers. The *Bahmeria nivea* or china grass, known also as "Tchou-ma," or "Ramie," is shown by three very carefully prepared slides, the entire fiber, a section of the same showing it to be quite distinct from the flax, hemp or jute, and a longitudinal and transverse section of the stem of the plant from which the fibers are procured. "Silk cotton," raw silk, raw wool, mohair, and others will give the reader an idea of the contents of this useful series. Mr. Flatters prepares lantern slides showing the details of the foregoing textile fibers, extremely valuable to all those engaged in technical instruction; the slides are prepared on a micrometric background, and every detail has been so thoroughly considered in their preparation that we have felt it our duty to bring them before the notice of our readers.—*Chemical Trade Journal.*

THE FIRST PHOTO MECHANICAL REPRODUCTION.

By JULIUS F. SACHSE.

PROFESSOR S. R. KOEHLER, curator of the Section of Graphic Arts in the Smithsonian Institution, and director of the Museum of Fine Arts in Boston, Mass., questions our claim made in the *American Journal of Photography*, October, 1892, that to Joseph Saxton, of Philadelphia, is due the honor of making the first practical photo-mechanical reproduction used on a printing press. He even goes so far as to deny that the Saxton specimen was a photo-mechanical reproduction in the accepted meaning of the term.

Professor Koehler in his exhaustive paper states that "a photo-mechanical reproduction" is one for which the printing form has been made principally by the action of light, aided by etching, washing out, etc., without the intervention of the human hand except for corrections, elimination of defects, etc.

The second requisite is that the printing should be done by mechanical means—*i. e.*, on a press. This second requisite the Saxon vignette as a matter of course meets, as it is printed from an intaglio plate on a roller press.

Then Professor Koehler goes on to state that the first requisite is not met. For even, he continues, "if the view of the mint should have been daguerreotyped on the metal block used by Gobrecht for the die, which is impossible, as the character of the view shows, it still would have had to be engraved or sunk by the human hand."

Now, notwithstanding above opinion by the eminent authority as above quoted, the writer still adheres to the original claim as made in the *American Journal of Photography*, October, 1892, and subsequently repeated before the Franklin Institute. The facts of the case simply stated are: In 1841, Joseph Saxton, a well-known Philadelphia scientist, made a daguerreotype of the Philadelphia mint for the purpose of obtaining a printing plate for the title page of a book about to be issued. The daguerreotype was then placed in the battery, and an electrotype made of the original. This was then backed with soft metal, and separated from the daguerreotype. Gobrecht, the engraver, then took this intaglio and strengthened certain parts with the graver, so as to give the necessary relief. When completed, an electrotype was then taken from this corrected intaglio and backed, from which the plate was ruled, giving, as Eckfeldt says in the text quoted, "a faithful and beautiful transcript of the original." As a matter of fact, there was perhaps much less handwork done on the first electrotype than there is on many a Goupil photogravure of the present day.

Further, this result was a practical plate, from which a large edition was printed. It may be of interest to state in connection with this subject that an electrotype portrait made from a daguerreotype may still be seen in the Gutekunst rooms, 712 Arch Street, Philadelphia. It is dated 1853, and was made by Mr. F. Gutekunst personally.

In view of above facts, the writer certainly thinks that in all fairness the objections to the first requisite are disposed of.

Professor Koehler further states: "Leaving aside, however, the question as to the nature of the Saxton vignette, it is not true under any circumstances that it is 'the first photo-mechanical production' made in the year 1841. Neciphore Niepce began his experiments looking to the making of printing plates, *i. e.*, plates printable in a press, in the year 1813. There is still in existence a plate made by him from an engraving in the year 1824. This plate is preserved in the Museum at Chalon-sur-Marne, and an impression from it is on exhibition in the Section of Graphic Arts at the United States National Museum, Washington, D. C. It is but fair to state that there is a slight doubt as to the absolute correctness of this date, as Niepce de Victor says that his uncle obtained plates made after the fashion of the one in question, 'since 1827.' The difference, however, is only three years."

This claim in favor of Niepce is not a new one. The

facts of the case are as follows: The impression alluded to is a portrait of Cardinal Georges d'Amboise, minister of Louis XII. The plate from which the print was made is of block tin, and it is alleged was obtained as follows: The metal is said to have been coated with a solution of asphalt and Dippel's oil (obtained by the dry distillation of bones). Upon the coated plate was laid Briet's engraving of the cardinal, and after being printed in the sun it was fixed with a solvent, and then lightly etched with acetic acid. Afterward it was sent to Lemaitre, a celebrated Parisian engraver, to have the lines engraved and deepened, so as to give it a printing character.

The strangest feature about this story is that no one knew anything about either plate or print until its disclosure after a lapse of forty years, by Isidore Niepce, a son of Nicephore Niepce, in a letter to Fouque, dated March 10, 1867, who was then compiling his "La Verite sur l'Invention de la Photographie" (Paris, 1867). *Vide* also, Dr. J. M. Eder, Handbuch, Halle a. S., 1891, pp. 109-114.

There is certainly no comparison to be drawn between this alleged crude attempt of Nicephore Niepce, which, even if true, was of no commercial value, and the practical result obtained by Joseph Saxton, the Philadelphia scientist, in the earliest days of the dawn of photography.—*American Journal of Photography.*

VARNISHES AND VARNISHING.

DR. VALENTA has dealt rather exhaustively with this subject, and he points out that the heating of the plate—so much objected to by amateurs—is by no means essential, as cold varnishes are quite satisfactory, if made and used to the best advantage. He speaks first of those cold alcoholic varnishes which are mostly solutions of gum sandarac in alcohol; but as such a solution of sandarac in alcohol will give only a matt surface, these varnishes contain certain other additions. Such additions are oil of lavender, oil of citron, etc., and he gives in the following a formula for the production of such a varnish, which he has thoroughly tested:

Gum sandarac	18 grammes.
Alcohol	100 c.c.
Oil of lavender	1 c.c.

This varnish dries rather slowly, but gives a solid and only slightly sticky film, excellently suited for retouching. In this regard it is to be preferred to others, which, even after hours of drying, will leave impressions if touched by the hand.

He then speaks of cold varnishes containing ammonia. Such a varnish is, for instance, the "crystal varnish" of Durkes. These varnishes are easily recognized, even if no great excess of ammonia should be present; or if they are perfumed, as when heated, they will always emit fumes of the ammonia, easily discernible by its odor and the alkaline reaction of the gas. These varnishes are an imitation of ammonia shellac varnishes used in collotype, and contain mostly shellac as the resin. This gum, dissolved in alcohol, does not give a clear film if the plate has not been heated before, while an addition of ammonia will result in the formation of clear films even upon cold plates. The ammonia is added mostly after the solution of the shellac in alcohol has taken place.

For the production of such varnishes a solution of ammonia gas in alcohol is, according to his experiments, the most suitable; in this the shellac will only swell in the cold, but will dissolve easily to a clear, yellow liquid when slightly heated.

In the following he gives a formula for the production of such a varnish:

Alcohol saturated with ammonia	100 c.c.
Shellac	8 grammes.

If the varnish is desired thicker, the quantity of the shellac can be increased up to fourteen per cent. The product on the market is made, as mentioned, by dissolving shellac in alcohol, and subsequent mixing with ammonia in aqueous solution.

Cold varnishes containing ether and acetone contain either sandarac or some other hard gum, and copal or amber, in which latter case they excel in quickness of drying and great hardness, while the cold varnishes of this kind containing sandarac are generally somewhat sticky for three to five minutes after flowing. In the following he gives a formula for the production of a very good rapidly drying and very hard cold varnish; 30 grammes angola copal and 5 grammes amber are powdered and mixed with

Ether	300 c.c.
Acetone	200 c.c.
Chloroform	10 c.c.

These gums are brought to a partial solution by prolonged standing in the solution, and shaking from time to time; or, what is simpler and quicker, the mixture is digested from one to two hours with the dissolving medium. A part of the gum will dissolve quickly, and a clear yellow liquid will form, which, poured upon glass, forms a quickly hardening, clear, and solid film, which is very good for pencil retouching.

Benzole cold varnishes generally contain sandarac or gum dammar. Varnishes prepared with the latter gum are always softer than the former. As these gums dissolve only with difficulty in benzole, artificial means must be employed, by treating first with alcohol, and then adding the necessary quantity of benzole. If proceeded with in this manner, clear varnishes are obtained, which furnish a solid; but, by employing gum dammar, a slowly hardening clear film.

A good formula of this kind is the following:

Benzole	90 c.c.
Alcohol	10 c.c.
Gum dammar	8 grammes.

This gum can also be applied to papers, and for this purpose a corresponding dilution is necessary. In such a varnish I have been able to trace a small addition of gutta-percha.

Collodion Cold Varnish.—Varnishes of this kind sold as crystalline, brassolline, or Zapon varnish mostly contain amyl acetate. They consist of pyroxyline which has been dissolved in amyl acetate and acetone with or without the addition of benzole, and sometimes camphor.

The quantity of amyl acetate in these varnishes makes the use of the same under certain circumstances very disagreeable; but they form very solid and well-adhering films.

Such a varnish can easily be produced by pouring 1,000 c.c. acetone upon 150 grammes pyroxyline, and then adding a mixture of 2,000 c.c. amyl acetate and 2,000 c.c. benzole.—*Photographic Work.*

A FEW CURIOSITIES.

JUST NOW, when the Columbian Exposition has attracted universal attention to so many strange people from out-of-the-way places, we feel sure that our readers will be much interested in the accompanying cuts

CAFFRE DOCTOR'S AMULET.

from Meyer's Konversationslexikon, for which we are indebted to our honored contemporary, the *Illustrirte Zeitung.*

The first of these engravings represents an amulet of the kind used by the charm doctors of the Caffres, a native race of Southern Africa. These people have no conception of a Supreme Being, but believe implicitly in witchcraft and the shades of their ancestors, swearing by the latter. Their charm doctors, rain makers and prophets exercise great power over them.

Other South African nations are represented by the

BATTA DANCING STAFF.

cuts of the Marutse dagger—which is more elaborately decorated than the amulet—and of the Herero woman's headdress.

Another picture shows a dancing staff used by the Batta, that strange race of cannibals living in Sumatra. Cannibals are usually supposed to be men of no intellectual development, but these have not only a very logical language, but also a written character. They write from left to right and their books are formed of the inner bark of a kind of palm cut into long strips and folded in squares, part of the wood being left at the ends to form the covers. But apparently this mental progress has not carried refinement or delicacy of feeling with it.

The cut of the Cingalese mask brings us to another

CINGALESE MASK.

people possessed of a rich language with a regular grammar. They have a literature that includes works on religion, botany, history and lexicography. These inhabitants of Ceylon, like their neighbors in India and the native races in China and Japan, are worshipers of Buddha. A bronze image of this god is shown in one of our engravings. As every one knows, all of these nations have attained a high degree of civilization, their industrial products being noted all over the world for their fine and artistic workmanship. This is exemplified by the picture of a glove, part of an East

MEXICAN STONE FIGURE.

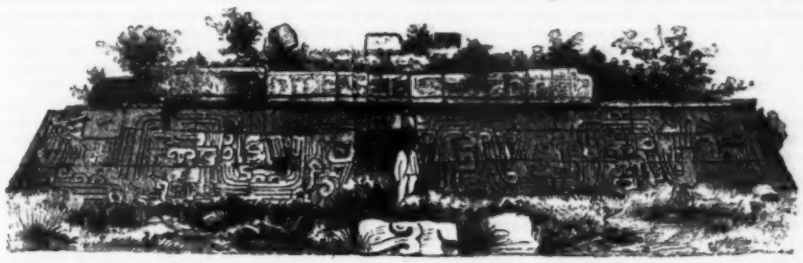
Indian suit of armor. But some of the less civilized nations also possess artistic skill, as we may see by the cut of the Bashkir decoration, that constitutes a portion of the costume worn by the people of this semi-barbarous race that inhabits the territory lying between the Caspian Sea and the boundary of Siberia.

The other cuts lead us back to our own continent, giving us a realizing sense of the fact that it, too, has

MARUTSE DAGGER.

its antiquities, although generally called the "New World." One is a stone figure found in Mexico, and the other the ancient pyramid of Xochicalco. The construction as well as the carving of this pyramid differ considerably from those of other Mexican pyramids. No one knows who built it, or for what

purpose it was constructed, notwithstanding the fact that there are many theories regarding it. Some antiquarians think it probable, however, that the builders were of the same race as those who built the palaces and temples of Uxmal and Palanque. It is situated on a hill 300 ft. high, which, with the ruins on its top, constitutes what is known as Xochicalco or the "Hill



PYRAMID OF XOCHICALCO.

BRONZE IMAGE OF BUDDHA.

EAST INDIAN ARMOR GLOVE.

HERERO WOMAN'S HEADDRESS.

BASHKIR ORNAMENT.

of Flowers." There are evidences that a deep ditch surrounded the foot of the hill, and five spiral terraces lead to the top. The walls that support these terraces are of stone and cement, and at regular intervals there are bulwarks shaped like bastions of a fortification. On top of the last terrace there is a rectangular structure 64 ft. long by 58 ft. deep. This is built of immense stones without cement. The stones were carefully smoothed and covered with carvings executed in a most energetic style.

THE EXHIBITION OF PAINTINGS AT CHICAGO.

THERE can be no doubt that the collection of paintings is a most important one, probably the most important of modern times, not even excepting that of the Paris Exhibition of 1889, at which the Germans did not exhibit and which was, in consequence, devoid of much of that catholicity of treatment which is present at Chicago. Commencing with the American exhibits, we notice at once the strong French influence which permeates the whole collection, some of the best canvases being those sent by artists residing in Paris, though many are by men residing in Rome and London.

As may be inferred, an American school as such scarcely exists, the difference of handling in each of the paintings being brought about by the influence of the schools in which the artists have studied. There is a good deal of conscientious work shown, and also a great deal in the worst French style, in which all the coarseness and vulgarity of its worst phases are painfully apparent.

In some of the smaller works, such as the landscapes, the subjects are treated with a certain amount of freshness reminding one of the best English work. Impressionism is met with here and there, but seems in general to have taken no great hold on the Americans as a body, while the figure subjects are numerous, and show an undercurrent of French influence in their handling. On the other hand, as was to be expected, the influence of the Munich and Dusseldorf schools is manifested in the pictures of those Americans who have studied there.

In the numbering of the pictures the senseless French system (or no system) has been adopted, so that if one wants to study the works of a particular artist, it is well-nigh impossible to do so, as the numbers do not follow in sequence, as at the Royal Academy, and you are, therefore, unable to find any picture from the catalogue. A large number of the pictures have been exhibited before in Europe. As to the subject-matter, the range is very wide, covering as it does everything from the ideal and religious, through landscape, seascape, domestic *genre*, and portraiture. The only subject especially conspicuous by its absence is historical painting, which was to be expected when one considers the comparative youth of the American nation, whose painters have not developed in an atmosphere of romanticism, but of realism. The works of the older American painters who have felt the influence of the romantic period are, however, represented by scenes from American life and literature, and Mr. F. D. Millet's "Anthony Corlaer the Trumpeter," Mr. Hovenden's "Breaking Home Ties," are examples of this phase. As indicating the scope of the collection, we may mention that there are over 1,100 pictures in the oil color section alone.

Among some of the more noticeable we remark: "Christmas Bells," by Mr. E. H. Blashfield, exhibited, if we mistake not, in the Salon of 1892, treated in a purely decorative way. Mr. Blashfield, by the way, has done some of the best work on the Manufactures building. Mr. T. W. Dewing sends his six figure subjects of the "Days," which are also treated decoratively, in a light key, the artist having more American character in his methods than many of the exhibitors. Among the religious subjects is the "Virgin Enthroned," by Mr. Abbot Thayer, treated in a novel manner, the Virgin being clothed in an olive green robe, with a pretty, wistful face, quite devoid of any religious feeling and treated in a purely material manner. Mr. Julien Storey sends his powerful "Mademoiselle de Tombreuil," an episode of the French revolution, full of color and animation, but with all the native artist's lack of finish. "The Flagellants," by Carl Marr, of Munich, is a very large canvas, perhaps the largest in the collection, and contains many half-nude men with bloodstained backs and scourge in hand; the subject is not an inviting one, but the technique displayed is beyond criticism.

As in other domains of art, so in painting, there seems, with the Americans, to be no general standard of excellence to which one can compare all the paintings, as in the European schools. "The Viking's Daughter," by Mr. F. S. Church, of New York, is an idealist study; the artist seems to be one of those who is tentatively striking in a new direction, and one feels sorry there are only two of his works in the Exhibition. Mr. Walter McEwen sends his "Les Sorcieres," previously exhibited in the Salon, in which the lurid light of the fire plays somewhat cleverly on the faces of the principal figures. "The Passage of the Red Sea" is a large canvas, showing Pharaoh pursuing the Israelites, full of life, movement, and color, but of the blood and thunder type. It is by Mr. F. A. Bridgeman, who is almost a Frenchman, having lived in France since he was a youth, and we think we remember the picture in the 1892 Salon. Hard by is a charming little landscape, by Mr. D. W. Tryon, of New York, of a setting sun, and called "Evening."

Mr. W. T. Dannatt, of Paris, sends a picture entitled "Spanish Women," in which six women are seated in a row, with the glare of the footlights on them, and represents to our mind the worst phase of French art, in which the coloring is daubed on in a careless way, and which, we suppose, would go under the high-sounding name of impressionism, writ large, but which, in this case, only covers up bad drawing. The "Peace" of Mr. Walter L. Dean, of Boston, is very satisfactory; it shows a man-of-war in harbor, with white painted hulk, the water reflection being cleverly handled, and all the minutiæ of the rigging faithfully rendered without any overworked effect.

Of the Munich-American school, Mr. Orrin-Peck's "Love's Token" is a good example, as also Mr. Toby Rosenthal's well-known "Dancing Lesson of Our Grandmothers," exhibited before at the Royal Academy, and afterward engraved. Mr. Whistler, who, by the way, describes himself as "of Paris," although in the engraving section he states he is "of London," sends six of his canvases, mostly lent by English owners. Among the landscapes those by Mr. George Innes, of Montclair, N. J., who is one of the most free from foreign influence, are of the greatest interest. Mr. Innes sends fourteen pictures, many of which are treated with great breadth and freshness. Mr. Homer Martin, who also has a name for this branch of art in the States, sends four pictures, the most important being "Behind the Dunes, Lake Ontario." Among portrait painters, Mr. Eastman Johnson and Mr. Sargent are well represented, and appear to take the lead in portraiture.

Mr. Winslow Homer, the great exponent of *genre* in America, sends fourteen works, in which he displays considerable insight into methods of portrayal of humor and of incident. From what has been said it will be seen how wide an area is covered and how difficult it becomes to select a representative number for discussion. It is a heterogeneous collection in which many fine compositions are to be found, treated with great variety of technique and varying degrees of excellence, and whose special characteristics are, in the main, drawn from the European schools in which the various artists have studied. The Loan collection consists of over 100 works from private galleries in the

United States, which are, it is needless to say, mostly French; only four Englishmen are represented, and of curiously different schools: John Constable's "Weymouth Bay," and "Shepherd and Flock," and the "Lock;" George Morland's "Contentment;" three canvases by Mr. John M. Swan; and one, the "Portrait of Joachim," by Mr. G. F. Watts, R.A. The remainder are principally by Parisian artists, and contain certainly some of the best productions of the school since 1800 A. D. It is perhaps needless to mention the pictures, but the collection includes some of the best works of such men as Diaz, Corot, Rousseau, Millet, Delacroix, Decamp, Fromentin, Daubigny, Troyon, Meissonier, De Neuville, Breton, Mauve, Ingres, Gerome, Fortuny, Manet, Degas, Cazin, and many others, which show how, in the past at any rate, the Americans have always had a most decided preference for the French school. There is a collection of over two hundred water colors in the upper galleries, among the principal exhibitors being Messrs. E. A. Abbey, W. H. Gibson, F. D. Millet, Arthur Rotch, and W. D. Smedley, amid a host of others. The collection seems much freer than the oil colors from external influences, and in the landscapese specially there is a breeziness, airiness, and freedom from restraint which is very refreshing.

The collection of engravings, etchings, and prints is a very large one, consisting of more than six hundred, the principal exhibitors being Messrs. Carlton Chapman, S. Colman, Chas. Platt, Alex. Schilling, T. Alden Weir, T. M. Whistler and others. Still more interesting, and placed under another group, are the pen-and-ink and wash drawings. To an Englishman these are no doubt far more interesting in a general way than the paintings. In no country has the cultivation of pen-and-ink work been so successfully studied as in America, nor, we think, with better results. This, no doubt, is really, as in most things, brought out by the great question of supply and demand. The American monthly and quarterly publications have created a demand for the highest class pen-and-ink and wash work; these, added to the improved methods of reproduction, have raised the American magazine illustrations to a pitch of excellence never before attained, and it is therefore with a considerable amount of interest that one looks at the originals. There are close upon five hundred of these, and among the exhibitors are all the best-known men, such as Messrs. E. A. Abbey, with his Shakespearean illustrations; Robert Blum; A. Castaigne, with his sketches of incident; Kenyon Cox; Harry Fenn; C. D. Gibson, noted for his humorous work and figure subjects; W. H. Gibson; E. W. Kemble; Alfred Parsons; Chas. S. Reinhart; and many others.

Whatever we may say as to the school of painting, there can be no doubt that America has a school of black and white of which she may well be proud, and which in many instances rises far above what obtains in European states. The best men and the best talent are employed on this work, therefore we need hardly wonder at the art attaining the position it has. The collection here should do good in educating the British public as to what is being done in the States, and leading publishers here to feel the necessity for producing the best work possible to be obtained.

The Germans have apparently made a special effort to form a collection of their best works on this occasion, perhaps because of the patriotic wish to show their compatriots at Chicago (which has considerably more German than American citizens) what the artists of the old country are doing, and also perhaps to make up in some way for their holding aloof from the recent great Paris exhibitions, where, for political reasons, they have not exhibited. The Dusseldorf, Munich, Berlin, Dresden, and Weimar schools, with others of less note, are well represented. A German, however, is nothing unless patriotic, and this patriotism is rather overdone when carried into the domain of art; as a consequence, we find the last three German emperors in every attitude and uniform and under every aspect of their august lives. Apart from these there can be no doubt that it is a well selected collection, in which drawing and coloring are carefully handled and in which we do not find any of that restless striving after effect which is the great danger to the Franco-American school. In landscape, historical and domestic *genre* and portraits the collection is particularly good. The larger room is fitted with a velarium, which is, we consider, a *sine qua non* for the proper and effective lighting of a picture gallery, and lastly, in striking contrast to the American section, is properly supplied with comfortable seats. One thing that strikes one particularly in the German gallery is the general somberness of the coloring as compared with the French. In domestic *genre* the collection is particularly strong, as in Herr Eberle's "Boarders," a work from Munich, in which a woman is surrounded by farm animals, portrayed by the hand of a man who evidently is fond of his subject and who has spared no pains to give us a faithful representation. If genius is, in truth, "the capacity of taking infinite pains," then surely there are many in Germany, and Professor Meyerheim's "Menagerie," from the National Gallery at Berlin, must be considered the work of one, for here, in a moderate sized canvas, animals and figures are huddled together with the greatest accuracy and completeness and with the same technical skill which is displayed in the elaborate ironwork of Mediæval and Renaissance times in Germany, but which, being opposed to fitness and the material, was the ruin of their Gothic architecture, leading to the introduction of technical difficulties in stone cutting, merely for the innate love of conquering them by scientific skill. When we look at such works we remark the cleverness but do not feel the art, and such a one the canvas under discussion appears to us; we remark the consummate skill and address with which the figures and animals are introduced, but the picture does not go further—does not, in fact, reach the higher domains of art.

Among portraits we notice that of Ibsen by Professor Smith, of Weimar, while of the many portraits of the Emperor there are three specially worthy of notice; that by Professor Koner, of Berlin, in which the Emperor is seated on horseback in the regimentals of the "Garde du Corps," is a very imposing affair, as also that by Professor Saltzmann, of Neubabelsberg, showing the Emperor whaling in the North Sea, and Professor Werner Schuch's large canvas of the Emperor reviewing troops is a fine composition, and is remarkable both as a portrait and as a military painting.

The portrait of Kossuth by Mdme. Parlaghy, of Berlin, reminds one of the late Frank Holl's treatment with dark background and clothes, showing up the clear-cut features of a white-haired man with skull cap. The portrait of Mommsen, by Professor Knaus, of Berlin, is a striking but not overpleasing treatment, a man seated at a study table and looking straight at one in a piercing way, which is very unpleasant. Professor Von Lenbach's portraits of Prince Bismarck and Pope Leo, both lent by the state of Bavaria, are remarkable not only for the excellent likenesses they undoubtedly are, but for the scholarly treatment he has impressed on them; that of Bismarck in blue coat and soft felt hat is the most characteristic portrait of him that we have seen.

Among military subjects the "Sudden Attack," by Professor Brandt, of Munich (by the way, every painter of any eminence seems to be a professor), is a fine conception; it is an attack on an inclosed farmyard, and is an attempt to portray one moment only, in which the alarm is given, the men mustering, the horses being saddled and made ready; the whole scene is one whirl of action, and is a subject which in general would be seized on by an impressionist; but here everything is complete, nothing is left to the imagination, and nothing is slurred over by bad drawing or coloring. It is an impression it is true, but one in which the camera would play the part.

In rural scenes and country life in every phase the Munich school is especially good, while Professor Leitz's "Music," representing a small group of people seated, is a fair specimen of the school of domestic *genre*. "Salome," by Herr Papperitz, with some fine color rendering of drapery, the "Congress of Berlin," by Professor Von Wernet, the "Death of Dante," by Otto Friedrich, are also noreworthy, while the "Navy-yard," by Herr Hochhaus, showing the construction of the German warship Oldenburg, must have taken years to paint. It is 12 feet long by 4 feet high, and hundreds of figures are at work at the side of the dock.

In the fields of allegory it is, perhaps, too much to expect the sober-minded German to roam with any degree of success, and it is rarely attempted. In one huge painting, however, 30 feet long and 18 feet high, Professor Keller, of Karlsruhe, has attempted to portray the "Apotheosis of the Emperor William I.," who is represented as seated in a car drawn by four horses, and followed by the Emperor Frederic and Prince Bismarck on horses, and preceded by outriders bearing the German flag, and surrounded by winged angels blowing trumpets, and about to place a crown of laurels on the Kaiser's uncovered head, the coloring and rendering of the whole conception being undoubtedly very fine.

The German collection has come as a surprise to the American public, and it will doubtless lead to a larger percentage of American students going to the German schools instead of all flocking to Paris, while it will certainly lead to a greater appreciation of German art by the American public.

Of the French section of the Exhibition we need not say much, partly because many of the pictures exhibited have been previously noticed by us when they appeared in one of the Salon exhibitions at Paris, and in fact we have for some years past commented annually on the condition of French art as illustrated in the Paris exhibitions; partly because, unlike that of Germany, the collection is not a fair representation of the present state of art in the country concerned. This is surprising as well as disappointing, as it had been understood that France was making special efforts to stand well at the Chicago Exhibition, and considering what appreciative purchasers French artists find in the Americans, it would have been expected from commercial considerations, if not for honor, that the French would have made every effort to appear at their best at Chicago. There are plenty of pictures, about seven hundred, but it can hardly be said that most of them represent the modern French school at its best, and those which do are already well known, and have been previously noticed in our columns.

Italy sends a collection of some two hundred paintings, which are no doubt illustrative of the state of the art in Italy at the present time. The modern Italian school seems to consist principally of any number of prettily and quaintly dressed peasant girls laughing and talking to one another, pictures in which the coloring is good and harmonious; and a certain number of sea pieces and domestic *genre* intermingled with scenes in which Venetian flower girls, with St. Mark's in the distance, are arrayed in colored gowns, softly blended; while some attempt higher art and portray a subject such as "A Village Fete," by Signor Armenise, into which are worked a certain number of figures, representing the joyous, laughing, and contented side of the modern Italian; in its way good art, inasmuch as it does this truthfully, in the same way as the men of Renaissance times never tired of painting the Madonnas and other biblical subjects which embodied the religious feelings of those days. "A Charge of Cavalry," by Signor Mancini, is very cleverly done in a sketchy way, showing a long line advancing at extended distance, full of movement, the further end sinking over a hill in the middle distance.

Among landscapes especially to be noticed is the "Overflow of the Nile at the Pyramids," by Signor Corrodi, representing a gorgeous sunset effect with the Pyramids in the distance. Signor Zanetti's pictures of Venice are well and truthfully studied, and his "Canal at Torcello" especially so, with the soft light effect of the grass and water, bringing it home with striking exactitude to any one who has seen it. Venice, with the Italian as with the European artist, is always a favorite sketching ground, and "bits" of life and character from the Queen of the Adriatic abound, in which the architecture (not too well rendered) plays the part of the background. In general the Italians excel in small landscapes and sea pieces, into which they throw a light and breezy effect entirely their own; and in the portrayal of fruit and still life they are admirable, as witnesses Signor Novo's "Fruitseller at Venice," in which pears, apples, and fruits of all sorts appear jumbled together in a brilliant realistic manner. The subjects are all small. Signor Corelli's "Angelus on St. Peter's Day" is among the larger ones on a more ambitious scale, and shows a sunset view across the Campagna, in which gayly clad peasants are harvesting.

As a general rule, although the level of the art of Italy at present is not high, it is something to be able to say that whatever is attempted is done well, and satisfies one in that respect, whereas anything attempted on a higher scale, and which fails, is always unsatisfactory.

The Belgian school is at once noticeable after France and Italy, on account of the somber coloring. As in the Italian school, the Belgian canvases are much smaller than in the French and German collections. Sea pieces are generally poorly treated, and of the muddy type, perhaps naturally inclined to be so under the northern sky, and possibly more difficult to render. The "Embarking of Emigrants at Antwerp," by M. Farasyn, is a busy quayside scene, in which emigrants of all types are preparing to embark to the New World, a scene which would naturally interest Americans, and in which a considerable amount of pathos and study of human nature is visible. We meet with pleasure the "Old Canal of the Roserie at Bruges," by M. Stroobant, a quiet rendering of one of the most pleasing of the old Belgian towns, in which, however, the architecture is somewhat stiffly treated. The curl of one huge wave by M. Bouvier is naturally and studiously rendered in a varying bright green.

From the figure subjects of Italy to the homely Belgian landscapes is a great change, as in those by M. Bayart and M. de Schampheleer, and others, in which quiet grays and browns predominate. The "Cupid in Chase," by M Ooms, an interior with women bathing in a bath inclosed with marble rim, rivals Mr. Alma-Tadema in the delicate texture of the marble. The most ambitious thing in the gallery is the "Holy Week in Seville," by the late M. de Keyser, a large painting showing a priestly procession; while the "Last Days of Pompeii" is perfectly childish, the result we usually find in what we may call the minor schools of painting when anything historical is attempted, in which imaginative fancy has to be joined to technical skill for any good result.

In groups of still life, in "bits" of red brick architecture, as the "Briele Pont, Ypres," by M. Meyers, or in the landscapes and canals by M. Courtens, there is much to admire, both in selection of subject and rendering. Of portraits there are few, and only one which deserves notice, viz., that of the Congo explorer, Jerome Becker, of Antwerp, a fine portrait by M. Vanaise, with a view of the city in the distance, and giving, as it were, a local habitation to the subject of the portrait.

In the Austrian section, more than any other, perhaps, one feels there is an inclination to really impressive religious painting; that is to say, in combination with good technique we find a religious *feeling* prevails—the feeling of painters who do their work for love of their subject, and to whom the notice of the public is a secondary consideration. The collection is small, and consists of about one hundred paintings, showing, more or less, the influence of the German schools; this especially noticeable in the type of paintings of which "Suffer the Little Ones to Come unto Me" is an example; it is by Herr Schmid, of Vienna. This old well-worn subject has, perhaps, never struck one with so much pathos as in this canvas. The portraits are very fine, and especially that of George Washington on horseback, by Herr Huber, of Vienna, in which the head bears all that impress of character which one expects to find in a subject like this. The allegorical presentations of the "Five Senses"—Hearing, Feeling, Seeing, Smelling, and Tasting—are among the most noticeable in the collection; they are by Herr Mackart, of Vienna, consisting of five separate canvases of semi-nude figures, in which the flesh tints are very skillfully rendered, with dark backgrounds of trees and bushes, scholarly and refined compositions, and taking a place, half way as it were, between the more somber treatment of the German school and the lighter play of fancy and coloring of the French. In landscapes, the Austrians are particularly weak, and those sent resemble chromographs in smoothness of texture. Among military subjects, the "Never Retreat," by Herr von Payer, is dramatically treated in dark tones, while the historical rendering of the "Fenstersturz at Prague," by Herr Brocik, of Paris, shows a decided French influence; it is a large canvas, 18 ft. by 12 ft., and full of life and color. It is, perhaps, in some of the smaller figure subjects of anecdote and incident that the Austrians are particularly fortunate, such as in the "Photographer" and the "Antiquarian," by Ludwig Gloss, and pictures of this type, rendered in a manner half way between Mr. Dendy Sadler and Mr. Marcus Stone, while others which "point a moral or adorn a tale," such as the "Dice Throwers," by Herr Hamza, are singularly happy in conception and treatment. Among classic subjects, the "Prometheus," of Herr Hirschel, reminds one of Mr. Poynter's compositions.

In a collection of about thirty water colors, those by Herr Rudolph Alt, of Vienna, are particularly fine and interesting to architects by the choice of subject; his "Interior of St. Mark's, Venice," contains very careful study of surface texture, his management of the well-known screen showing considerable study of architectural drawing.

The "land of Rembrandt" sends a complete and characteristic collection of 200 oil paintings, besides over 100 water colors. The restful and soberly-colored grays and browns in the landscapes, and the seascapes and views across the quaint dikes and canals, with bits of shipping, are very refreshing after the higher flights of the more important schools, and give us an insight as it were into the trim and homelike character of the people. The old almshouses and the like appeal especially to the architect as the prototypes of our most popular phase of domestic art. The study of the nude hardly seems to fit in with the Puritanical education of the modern Hollander, which would, no doubt, make glad the heart of the "British matron" and Mr. Horsley, R.A., while the want of it certainly makes itself felt in the drawing of some of the figure subjects. Among Dutchmen in London, Mr. Hubert Vos sends important contributions, and his portrait of the Queen of Holland is founded evidently on the old Dutch masters. A large number of women painters exhibit, mostly in subjects of still life.

As was to be expected with anything Spanish, with that delightful indifference to modern ideas, so very

refreshing in these progressive days, we find that their pictures are neither numbered nor catalogued! In a country which has had such a glorious past, naturally one finds many historical canvases, and among them, of course, "The Landing of Columbus," while interiors of bull rings, pictures of anecdote and incident and still life are prominent; the special characteristics of these lie in the vivid coloring and sunny atmosphere of Spain. There are one or two small military charges, almost impressionist in rendering, and with a certain dash and freshness always pleasing when not overdone. The picture showing Don Quixote and Sancho Panza is quaintly rendered with a considerable amount of humor.

The Russian collection consists of over 100 pictures lent by the Imperial Academy of Fine Arts at St. Petersburg, many of which are quite modern, while others date as far back as 1800. The influence of France and Italy is clearly visible, while all have that brilliant coloring which we should imagine so grateful to the beholder in a Russian climate. There are no portraits.

The state of art in Norway and Sweden we should imagine to be at a very low ebb; the only really presentable picture is a portrait of Nordenskiold by Count von Rosen, showing the discoverer on a glacier with his ice-bound ship in the distance. Many pictures appear to be executed as "Impressions," but it is that phase which is adopted to hide bad drawing, and as such is worthy of the strongest condemnation.

Japan has never before been represented in the art department of an international exhibition, but recognizing the radical difference existing between Japanese methods and those of the western world, the art department at Chicago did not bind Japanese art exhibitors to the somewhat formal classification established for other nations, but with commendable open mindedness endeavored to procure a thoroughly national exhibit, in fact, such a one as would be obtained in Japan itself, and M. Tegima, the Japanese commissioner, has certainly made the most of the opportunity. Of this portion of the art exhibition we will speak separately on another occasion.

We have left the English collection till the last, not because of its inferiority in any way, but because the pictures are mostly known to Englishmen. It is, however, with a certain sense of mingled satisfaction and pride that we pass through the seven large galleries abutting on the great East Court of the Art building, an important position quite justified by the exhibit; therein are collected over five hundred of the best pictures of recent years, a collection which, in the number and quality of the work, is even more important than that at the Paris Exhibition of 1889.

Forty-eight of the leading members of the Royal Academy, past and present, exhibit their most important works, besides all the more prominent outside artists and members of the Scotch, Hibernian, and Cambrian academies. There is no doubt that the collection has created a most favorable impression in the United States, amounting almost to a "furor," the galleries being always crowded, often to an uncomfortable degree. This impression is the more marked because few English pictures have been exhibited in America during recent years, and all that the average American knows of English art is the remembrance of the Philadelphia Centennial Exhibition, a very poor show as far as the English exhibit was concerned, in which the Faeds and the Friths and the Coopers of that period held prominent sway, and which did a great deal to discredit English art on the American continent. Furthermore, the selection of pictures was not made with anything like the same amount of discrimination exercised in the present instance, where, with Sir F. Leighton at their head, the committee have made a most careful selection from all the most prominent works of recent years. It is not too much to say that for general excellence of standard the exhibit is beaten by no other country. This, moreover, is not the expression of an insular prejudicial mind, but the opinion of the large majority of American critics with whom the writer has come in contact, and who have not failed in American journals to give expression to their opinions, all the more valuable as coming from men who are not, as a rule, inclined to overrate anything English.

The collection, it is certain, will create a revulsion of feeling in favor of English art throughout the American continent.—*The Builder, London.*

THE NEW CONGRESSIONAL LIBRARY.

THE Library of Congress will be second in size to but one building on this continent, the National Capitol, from which it is separated by a narrow expanse of wooded park. While magnificent in its proportions, its nearness, too, in no way detracts from the grandeur of the Capitol, nor does the contrast belittle its own dimensions. Italian Renaissance is the period represented, and granite the material employed. The general features are arranged so as not only to express the purposes they are intended to serve, but in so doing to form the decorative as well as the useful features of the building. There are no superfluous porticoes, no obstructive pediments, but a pleasing and reasonable design throughout. The granite pile rises cool and gray from its emerald setting of trees, suggesting solidity, restful to the eye, and a pleasing contrast with the marble fairness of the Temple of Fame on the west.

Slowly, but surely, this immense structure is nearing completion. The interior walls, of brick, are completed and roofed in. The exterior walls, of granite, are finished to the top of the third story. The dome is already incased in its copper coat, and the lantern has its iron ribs concealed under a leaden-colored jacket. The whole thing rounds up against the azure like a gold crown with a silver topknot. It gleams and glows and flashes under the sun's fervid kisses, and the silvered lantern fades into the gray blue of the evening sky, till it suggests St. Peter's chair and the gateway of the celestial city whose pearly dome and alabaster walls rise in white beauty just beside it. A slender fretwork of black stands out against the copper. It proves to be, on near approach, a heavy iron balustrade protecting a promenade about the dome, and a second one is around the base of the lantern. Some day the dome proper and the top of the lantern will be gilded, and then Boston's Beacon Hill ornament will have to hide its diminished glory, or, at least, take a back seat.

The ground plan covers nearly four acres. The three floors will represent twelve acres. The ground plan represents 12,800 sq. ft. more than that of the British Museum, 11,000 more than the Royal Library of Bavaria, and 21,000 more than the War, State, and Navy buildings. It has a storage capacity for fifty miles of books, or, in round numbers, 5,000,000 volumes, which is something over 4,000,000 more than the United States now possesses. Twenty-five millions of bricks are used in the walls that line the inside of the granite bowlders which form the exterior surface. It has 1,500 windows, not counting the glass book stacks nor the skylights.

The construction is as thoroughly American as it is possible to make it. Those twenty-five million bricks are manufactured out of American mud, grown in the District of Columbia. Pennsylvania and New Jersey furnished all the iron used in the construction of the main body of the building. The iron arches used in the big dome were made in Indianapolis. New Hampshire furnished most of the granite, and the remainder is a product of Maryland. When the workmen get ready to put in the flooring, Massachusetts will furnish the handsome tiles. The pretty "china" bricks that give artistic finish to the inner court were made in Leeds, England. They are manufactured in this country now, but at the time the contracts were let neither quality nor quantity was up to the requirements. Italy will be called upon to furnish the marble for the interior ornamentation. The kind of marble required does not grow in this country.

Being "the heir of all the ages in the foremost files of time," the architect has adopted from the mass of material offered by various periods something of beauty and utility from each for this great structure. Science has not been chary of her secrets, and Art has given of her noblest and most enduring treasures to relieve the severity of both interior and exterior. While strictly utilitarian in every sense of the word, simple elegance and artistic solidity have been the achievements. Nowhere is this more strikingly illustrated than in "the book stacks," as the receptacles for the books in common use are titled. Adjoining the general reading room in the rotunda and crossing the inner court, one on the north and one on the south side, are two tall structures which look like big three-storied conservatories. These are the book stacks. They stand 65 ft. high, of solid glass, with framework of iron. Each is 112 ft. long, 45 ft. wide, and has nine stories. The shelves are made of iron, in gridiron fashion, and there is just room enough between the bookcases to afford narrow passageways for the attendants. No impious alien's footsteps will ever echo along those aisles. There are two of these book stacks, each fitted to accommodate 800,000 books. The present collection will not fill one of them. But there are a million things in the Congressional Library collection besides books.

The mice that gnaw those book shelves will have steel teeth, and the dust, mould, and book worms that infest the damp, dark dungeon where the library has been stored so long because of Congressional penuriousness will have to emigrate to more congenial climes. They all hate sunshine, and old Sol won't crack a smile from the time he washes his face in the Potomac in the morning till he bathes in the salt water of the Pacific at night, that will not only penetrate that ingenious book stack, but every nook and corner of that whole great building as well. Those are two of its strongest points, sunshine and pure air. The walls of the court into which the book stacks project are constructed of white enameled brick as smooth and polished as a dinner plate. They are impervious to dust or moisture, and have splendid refractive qualities.

It is nearly a Sabbath day's journey as they counted it before steam, cables, and electricity, to get around that building, and the most complicated mechanism has been summoned to the aid of aching legs. In the big rotunda, under the skylight, is the main reading room, and in the center is the librarian's desk. This is about the only feature that may be said to be copied without modification or embellishment. It is adapted from the plans of the British Museum. Around the librarian's desk, radiating like spokes from a hub, are ranged the desks for the readers. Here, within range of the librarian's eyes, there will be accommodations for three hundred people to read and write. From the center desks to the book stacks, in a tunnel, is stretched an endless chain, with metal baskets attached. It is noiseless and automatic in action. Each tray has its station in the book stack, and unloads its freight of books at that point. Re turning to the reading room it empties its contents, and stolidly travels back for more. It never gets tired, never makes a noise, and never goes on a strike. There will be private reading rooms for the use of Congressmen who are not too lazy to walk over there to use them. A miniature tunnel will connect the Capitol and Library, and through it, by pneumatic force, the volumes used in preparing original speeches adapted from the ideas of the ancients will be whisked to impatient statesmen. High-salaried clerks and the *Congressional Record* will do the rest. There will be pretty little alcoves for the use of the privileged students, and around the inside of the dome, above the reading room, will be a handsomely decorated lobby, from which the inquisitive stranger can view the literary animals and not disturb their ruminations, and the guides can relate their remarkable tales unchecked.

There will be a cold storage room, too. It will hide itself somewhere under the big roof, but the general reader will never find it. Ten chances to one if he ever knows of its existence except as he hears vague rumors that Librarian Spofford has a Blue Beard's key that everybody is warned not to touch. In that room will be stored classic eroticism, too vile to be placed before the public, yet like certain canvases of old masters, considered such exquisite pen pictures of the nude in literature that they must be preserved. Chief among them are novels of the Elizabethan period and family papers circulated in London high life in the latter part of the eighteenth century. If there is ever a fire in the big granite palace, spontaneous combustion in this department will be the probable cause.

There will be a museum somewhere in the labyrinth of rooms, and a book bindery. Up to the top, probably in the southwest corner, there will be a restaurant. There might be one in each corner, for there is a chance to get hungry in going from one to the other, but one will fill all the requirements of Librarian Spofford, though book worms do not form any part of his menu, as many suppose. Up there, while he feeds his mentality on baked beans and blue fish, he can also feast his artistic senses on the scene without. He can view the storied Potomac from Arlington's grove-crowned heights, past drowsy Alexandria, clear to historic Mount Vernon. He can nod almost on a level to Miss Liberty on the dome of the Capitol, and within the sweep of his vision around the horizon he has a scope of country that has more stirring history to the cubic foot than any other ten miles square of country in the universe.

Along the east side of the library grounds there is a low glass-roofed structure that might be a conservatory or greenhouse, but happens to be the boiler house. Beside it stands a splendid granite monument—that is, it might be, but it isn't. It is a smokestack, not of the lower regions, but of the engine house. The inner walls of the boiler rooms are of enameled brick, and all this magnificence incloses sixteen huge boilers, which furnish the heat for the library building—heat that pushes itself through fifty miles of steam coil before it will warm Librarian Spofford's shins to the proper temperature. The boiler rooms are thus remote, so that all possibility of fire may be reduced to a minimum. There seems absolutely no chance for fire except it be from spontaneous combustion in that cold storage room or in the department sacred to the *Congressional Record*.

Those who gaze with understanding eyes upon the simple exterior decorations will have ample education to cope with life's disadvantages. So arranged that they form eight keystones on each of the four sides of the building are thirty-two heads, representing the types of mankind. Each head is carved from granite, after a picture taken for the express purpose by ethnological artists. There is a barbarian from somewhere who pierces his lower lip and attaches a dinner plate or butter bowl, and thus achieves his idea of ornamentation, and the father of the society girl who hangs plate glass in her ears and hopes that it will be mistaken for the Kohinoor. There is the woolly headed son of Africa and the carnivorous cutthroat Sioux. The head of Apollo and a Persian whose eyes are invincible even in stone. They are all there to the number of thirty-two, and that is enough for ornamental purposes, according to the sculptor, Mr. Boyd. Some ethnologists make more races, some not as many, but just now Gen. Casey, Mr. Green and Mr. Boyd are working upon the theory of thirty-two. Any more would be an embarrassment of riches and ruin the symmetry of their plans.

Here is a building which will endure while time lasts and be an ornament to any age.—*Chicago Tribune.*

IN THE BANK OF ENGLAND.

ONE of the first objects of interest upon entering the building is the bullion office, where all the gold and silver that enters or leaves the bank passes through to be checked, says a writer in *Harrison's Magazine*. On the right is the gold; on the left the silver. The prominent feature of the room is the "grand balance," or scales, constructed by the Messrs. Napier. This marvelous instrument is a ponderous and peculiarly built weighing machine, standing nearly 7 ft. high and weighing about 2 tons. The whole is under a huge glass case, access being gained thereto by a sliding panel. The scale is worked by hydraulic power, and is the most sensitive weighing machine in existence. On each side the scales are fitted with weights amounting to 400 ounces. The gold is made up in 400-ounce bars, and the difference of one-thousandth part of an ounce can be detected. By a manipulation of the machine, so tiny a thing as a postage stamp can be weighed, for on the same being placed upon the scale the index will jump a distance of no less than six inches. It is the only balance of its kind in the world, and cost about $10,000. The silver scale is not so finely balanced, and the two are respectively christened "The Lord Chief Justice" and "The Lord High Chancellor." In another room are several machines for weighing sovereigns and half sovereigns. Each machine consists of a complicated system of counterweights, and it is not unlike a sewing machine as to its lower half, the whole being completely inclosed in glass. A long feeder, like a tube cut in half down its length, and made of brass, is set at an angle of 45 degrees, and is filled with a long roll of sovereigns. These turn as they slip down on to a circular movable plate, slightly larger than a sovereign. If the coin is of the right weight, it slips down a metal tube into a till below. Should, however, it prove to be lighter than the standard, the delicate machine turns to the left and condemns it to the guillotine. These machines weigh coins at the rate of twenty-six per minute, and a day's weighing at the bank amounts to about $500,000.

Another interesting feature is to be found in the vaults containing the defunct paper circulation of the bank. Some idea can be gained of the quantity when we say that they are over 77,000,000 in number, and that they fill 1,400 boxes, which if placed side by side would reach two and a half miles. If the notes were placed in a pile they would reach a height of five and a half miles; or if joined end to end, would form a ribbon 12,455 miles long. Their superficial extent is little less than Hyde Park; their original value was over £1,750,000,000, and their weight exceeds ninety and a half tons. Among them is a note for £1,000,000, also the first bank note ever issued (one for £500), and another for £250 left at the bank for 111 years, whose accumulated interest raised its value to £60,000. The printing of the existing paper currency is an interesting process. The notes are struck off two at a time on hand-made paper, which, upon being cut, gives three rough edges and one smooth one to each piece of paper—a distinguishing feature of a Bank of England note. The paper is manufactured at the bank's own mill, and the production of it is intrusted entirely to the members of one family. The ink used in printing the notes is made from the charred stem of the Rhenish vine, which is believed to produce the richest black of any ink in the world. Each strip of paper has to be strictly accounted for, the whole process being under effective supervi-

sion. The bank can boast of possessing the wealthiest room in the world, in the shape of a kind of vault surrounded from floor to ceiling by iron safes containing rows upon rows of gold coin in bags of $10,000 each, and pile upon pile of bank notes. The amount of specie contained in this room is not less than £80,000,000 sterling.

Not the least interesting feature in connection with the bank is the fact that the whole system from beginning to end is under constant police espionage, in addition to military protection, and the electric arrangements are so complete that communication with all parts of the building can be effected at a moment's notice.

THE WAR IN AFRICA.

By ARCHIBALD R. COLQUHOUN.

THE responsibility for the war rests neither with the British South Africa Company nor with Lo Bengula. The blame lies with the "war party" in Matabeleland—in other words, the "matjaka," the young unmarried soldiery who have been at all times impatient of control by their indunas, or chiefs, and even by the king himself. There has been from the first on the part of the High Commissioner (Sir Henry Loch), Mr. Rhodes and Dr. Jameson, prudence, patience and skill in the conduct of our relations with the Matabele, with the view of averting collision so long as it could be avoided or even postponed. Lo Bengula has throughout been subject to circumstances which occasionally overmaster the very ablest and most powerful rulers—the will of the people; or, as in Matabeleland, that of the military hierarchy, of which the most dangerous section, again, is the "matjaka." I well recollect when the Pioneer Expedition started on its journey to effect the occupation of Mashonaland, it was a matter of grave doubt whether Lo Bengula would be able to control the "war party," and the situation at various times during the progress of the expedition was undoubtedly critical. He had no desire to fight; not that he was particularly friendly to the expedition, but he understood the strength of the white man and the inevitable result of collision. He had a most difficult part to play to retain his seat on his throne, his head upon his shoulders; and, in order to accomplish this, he was obliged to manage the "matjaka" with great tact and adroitness. Any symptoms of either yielding or wavering might at any second have cost him his life. At last, three years after the occupation of Mashonaland, the "matjaka" got the upper hand, and forced what was practically a declaration of war. That my view is well founded is borne out by what Sir Sidney Shippard, the Administrator of Bechuanaland, wrote in 1888 on the condition of Matabeleland when on a mission to Buluwayo:

"Lo Bengula's power of restraining the matjaka is said by those best acquainted with the country to be greatly diminished within the last few years. The older indunas, the companions of his boyhood, are said to be still devoted to their chief, but the younger regiments, many of which can boast of no Zulu blood, and consist entirely of maghole, *i.e.*, slave boys or captives taken in war, and trained up to become matjaka, are said to be anything but loyal to Lo Bengula. It is impossible to forecast the future in such a country as this. A matjaka rebellion, attempted revolution and civil war appear to me to be not unlikely. . . . . Some of the older Matabele indunas and indodas are confessedly sick of carnage and desire nothing so much as a peaceful government, with security for life and property, not to be obtained under the present *regime;* but the restless and bloodthirsty matjaka are perpetually craving for the fresh slaughter of helpless victims, who attempt no resistance, and make but feeble efforts to escape by flight or by betaking themselves to hiding places, and Lo Bengula dare not withstand the impetuosity of his troops, even if he would."

A DECISIVE BLOW AND ITS EFFECTS.

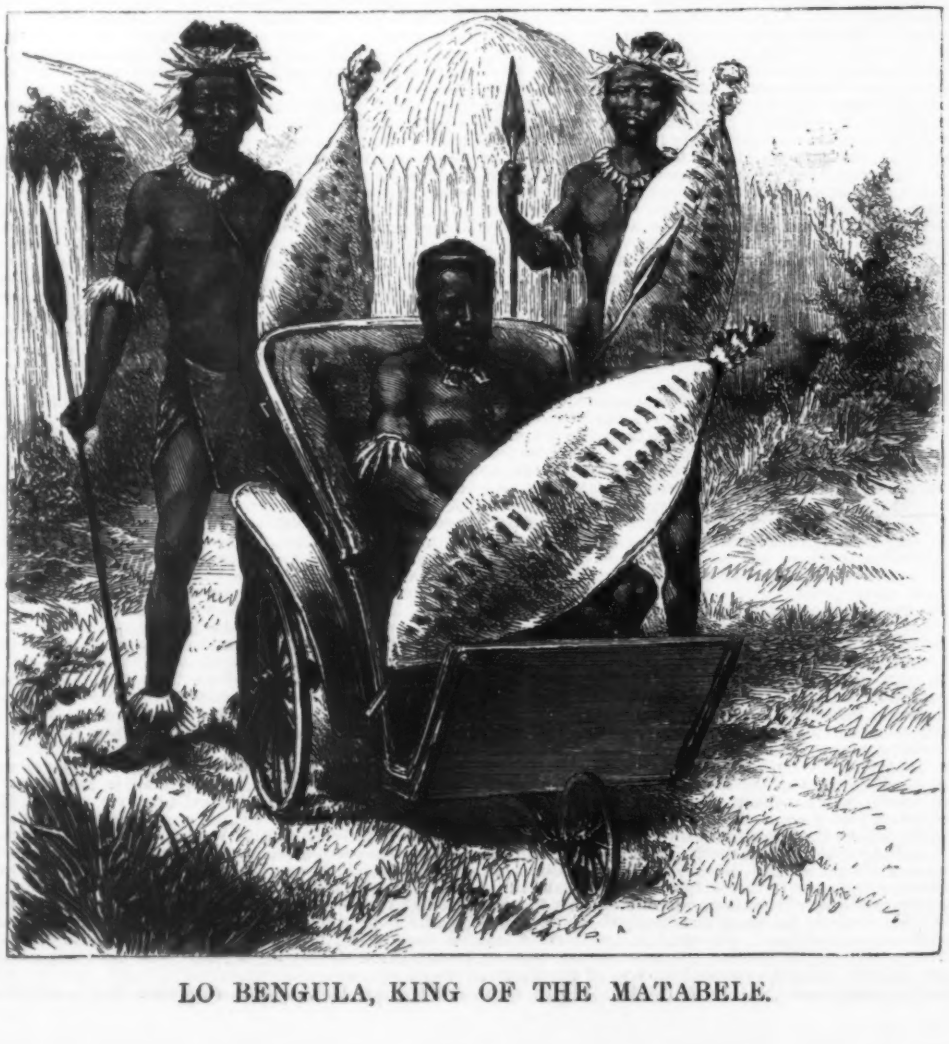
It is now a life struggle between the pioneers and their neighbors, and a decisive blow must be struck at the Matabele power which will shatter the military prestige and power of that nation. This accomplished, the greater portion of the people would, I believe, remain in Matabeleland, and settling down to peaceful pursuits—of which mining would be an important one—become incorporated in Zambesia, while probably some of the irreconcilable indunas and their warrior followers would move northward and establish themselves in some district north of the Zambesi. I certainly do not think the whole Matabele nation will trek bodily northward.

The Matabele are not all warriors. They possess much of the raw material of a tolerably peaceful and hard-working people, and of this a certain proportion has already tasted the sweets of justice and regular payment of wages in the Transvaal and Mashonaland; but the greater part is locked up in the military system prevailing in the country. Once the military system is broken up, the more peaceful and industrious elements will detach themselves and settle down. I am sure it will be the policy of Mr. Rhodes to prevent anything like this much-talked-of trek, for two very good reasons: first, to prevent the establishment of another standing menace north of the Zambesi, which would prove most disadvantageous to the territory south of that river and to that controlled by Mr. H. H. Johnston, at Nyassa; secondly, to retain an adequate native population for the development of Mashonaland, so absolutely necessary a desideratum. The future prosperity of the country depends largely upon a sufficient supply of native labor; and once the company's forces have broken the military caste, the rest of the people will not delay, in my opinion, to come to terms with Mr. Rhodes, who has always shown a strong disposition toward compromise when compromise is the wise course. White labor, it must be remembered, is out of the question in these distant regions. Even at Johannesburg and Kimberley the mines would have to close to-morrow if native labor were not available.

CHARACTER OF THE COUNTRY.

The public is sufficiently acquainted with the general geography of Matabeleland and Mashonaland, by means of the maps which are almost daily appearing in the press, to render any lengthy description of these countries superfluous within the brief limits of this *Supplement*. A few words on the subject, however, are necessary. The country both south and east of Buluwayo presents considerable difficulties, the main approach from the south being through a pass which it would be, I have always understood, highly dangerous to traverse, while the region between Forts Victoria and Charter and the Matabele capital in parts is hilly and broken, traversed by rivers and streams, and therefore not well suited for the operations of mounted troops. It is to be hoped that the opportunity will present itself to the company's forces to engage the Matabele troops in the open high veldt in the neighborhood of Buluwayo, or at the capital itself. The two columns from Victoria and Charter are reported to have effected a junction, and if that has been accomplished at the headwaters of the Sabakwe River, a great point will have been gained, for the road

SOUTH AFRICA, SHOWING POSITION OF MATABELELAND.



LO BENGULA, KING OF THE MATABELE.

along the open tableland on the watershed will then be open to Buluwayo.* At convenient points laagers (consisting of a number of wagons drawn up in defensible position), as bases for supply or defensible posts in case such be needed, are being formed.

The policy of the Matabele will probably be that of the waiting game and to draw their enemy into the hills, *if Lo Bengula have power to control*, for he is too astute, I should think, to allow his forces to be engaged in the open, or to miss taking due advantage of the rainy season. He must be well aware that the rains will prove for him an invaluable ally. It is doubtful, however, whether he will be able to exercise proper command and direction of his impis. The Matabele will fight with the assegai and stabbing spear; the breechloaders in their possession will hardly be employed, for they will be practically useless to them, not having been kept in working order, while they lack means of obtaining ammunition, and, to crown all, are unacquainted with the use of such arms of precision.

THE MATABELE ORGANIZATION.

The Matabele nation, which is more a military organization than a tribe, though Zulu in origin, language, customs and methods of warfare, has greatly degenerated from the original Zulu stock by the incorporation of the inferior tribes they have raided and conquered from time to time. They live under a military despotism, presided over by the king, who is absolutely master of everything. There are no industries, the tribesmen living mainly by the assegai and the cattle captured on raids. On these expeditions, or forays, the men and old women are massacred, the children and young women being carried away, and marked as Matabele by a hole made with an assegai in the lobe of the ear. The lads grow up Matabele, and in time become soldiers, the girls being taken as wives by their captors. The result has been a race originally Zulu, intermixed with Bechuanas, Mashonas, Makalakas, etc., held together by the military bondage and organization. Thus degenerated, they are living largely upon the prestige and power of their progenitors, the famous Mosilikatse (Lo Bengula's father) and his warrior followers. The number of fighting men is estimated as fifteen to twenty thousand. The whole fabric may be easily shaken or broken.

LO BENGULA.

The king, as already stated, is master of everything and every one throughout his territories, and a terror to all his neighbors. Like other absolute monarchs, he is maintained by the military, and only with their approval, and he has to be very cautious, as before mentioned, how he deals with them.

Lo Bengula, literally, "The Defender," and the bearer of many grandiloquent titles, such as the "Great Elephant," the "Eater of Men," the "Stabber of the Sun," is sixty years of age, suffers from gout, and is enormously fat and unwieldy in person, which tends greatly to diminish his otherwise kingly appearance. He is close upon six feet, weighs nearly twenty stone, and rarely takes physical exercise, although he has been very active and very powerful. He is a man of extraordinary character and ability, with great power of work. The descriptions of Lo Bengula's personal appearance range between that of a most truculent and bloodthirsty savage, with a "deadly cruel" look in the eyes, and a pleasant, mild-mannered old gentleman, with a gentle, winning, childlike smile. It is probably wise to adopt neither of these extreme portraits. There seems no doubt that on occasions he has a singularly sweet smile, softening the usual character of his face, and with him, as with despotic monarchs gifted with such smiles, these occasions not unfrequently bode somebody no particular good. His natural disposition is said, by those who know him well, to be not cruel; but the exercise of unrestrained despotic power, surrounded by intrigues, has led to indifference to life, whenever it seemed to him a matter of policy or as not unfrequently self-preservation. Relations and friends alike have been removed when "inconvenient." There is no doubt as to his great intelligence; he goes to the bottom of a question, never being diverted from it. His memory is great. He hears reports from all quarters, settles difficult questions of law, judges criminals, and settles details of his enormous cattle business. A favorite seat is the wagon box; at other times a veritable Bath chair, given to him by some English admirer, in which in his cattle kraal, wrapped in a colored blanket, his feet swathed in dirty flannel bandages, in the midst of dirt and discomfort, skulls of slaughtered bullocks, and surrounded by mangy pariah dogs, he was frequently to be seen.

The fact that Lo Bengula succeeded in restraining the war party so long speaks volumes as to his force of character, tact, and diplomacy. As illustrating his capacity for business, I may here mention that when I was serving in Mashonaland he sent Mr. Dawson, an Englishman, as his emissary to investigate some of the gold fields, and to secure for his majesty certain interests therein—an arrangement which was concluded with satisfaction to himself and to the company.

MATABELE WARRIORS.

THE APPROACH TO ROYALTY.

The manner in which the Matabele approach the king is very peculiar, and unlike that common in many eastern countries, and is emblematical of the absolute power over the lives of the subjects exercised by the king. The king's titles are shouted out when any one passes the gate of the kraal on his way to approach his majesty. When about twenty yards from the king, the subject sinks his left shoulder, and bends his knee, and crouches lower and lower until, when some half dozen yards from the royal presence, he squats down and recommences to sing with vigor and earnestness the praises of the "Stabber of the Sun." It may by imagined that the suppliant infuses considerable

* Since writing this article news has been received of the engagements of the 16th, which seem to show that the company's forces, after successfully engaging bodies of the Matabele, have now an open road to Buluwayo.

feeling into his chant, as very much, not impossibly even life itself, might depend upon his reception by his majesty.

WITCHCRAFT.

Witchcraft forms a very important factor in the Matabele economy, and, as already indicated, has exercised a powerful influence over Lo Bengula. He was much addicted to the sacred duties of "medicine" or "mystery" of various kinds, which he practiced in the more holy of his kraals—the goat or "buck" kraal—daubed all over with paint. Witchcraft is made a convenient lever for getting rid of people who may be in the way, and Lo Bengula has on various occasions availed himself of this hideous superstition. Evidence is not required to prove, or permitted to disprove, any accusation. Lo Bengula's own sister Nini, who for years was a most influential personage in Matabeleland, and whose prestige was largely maintained by her use of the powerful weapons of bringing charges of witchcraft against persons whom she disliked, was herself suddenly dispatched on a charge of witchcraft. As with nomadic pastoral races generally, "rain-making" forms an important function of the king as chief magician, and in this Lo Bengula is credited by his people with being a proficient. His reputed skill in rain-making gives him an additional hold upon the loyalty of his people, whose very existence depends to a large extent upon the provision of suitable pasturage for their cattle.

OUR ALLY, KHAMA.

The chief of the Bamangwato tribe, Khama, is a Christian and the most enlightened and civilized of South African rulers. His character is a fine one—firm, just, and earnest in the desire to raise his people. The Christianity of Khama is eminently practical, and he practices what he preaches. He holds most decided views on the use of intoxicants, and no wine or liquor of any description is allowed to be sold anywhere throughout his territory; even the brewing of the comparatively harmless Caffre beer is, without exception, heavily punished. Khama feels so strongly on this question that he once expressed the opinion that he "feared the Matabele less than brandy." He wrote in a remarkable dispatch in 1888: "Lo Bengula never gives me a sleepless night, but to fight against drink is to fight against demons, not against men. I dread the white man's drink more than all the assegais of the Matabele, which kill men's bodies and is quickly over; but drink puts devils into men, and destroys both bodies and souls forever. Its wounds never heal." A proof of Khama's humanity is that when some four years ago the seat of government was moved from Shoshong to Palapye, to secure better water and a more advantageous site, all the old and infirm were carefully removed from the old capital—a most un-African method of dealing with the aged, who, regarded as an incumbrance, are left to shift for themselves. Mr. Hepburn, the missionary, has been for the past twenty-five years the devoted guide and friend of the Bamangwato. Seated under some shady tree in his "sigadhlo" (an inclosure where court is held), Khama is always accessible to his poorest subject, and is prompt and wise in his decisions. Khama can muster over 7,000 fighting men, of whom about 1,000 are armed with rifles, and he has some 300 mounted men, not uniformed in any way, of whom he is very proud. Khama's men cannot be counted upon as very reliable fighting material, for the Bamangwato are not a warlike race; but among them will be found very useful auxiliaries, especially for scouting purposes. They did excellent work on the pioneer expedition, under the guidance of Selous, when we entered Mashonaland in 1890.

TATI.

Ninety miles north of Palapye, through a rolling country at present uninhabited, is Tati, a small mining settlement, where are situated the gold reefs belonging to the Tati Gold Mining Company. It stands on the main road into Matabeleland, and is the border town between that country and Khama's possessions, close to the northern border of what is known as "the disputed territory." Its position and occupation by the Bechuanaland Border Police make it a point of importance. Some 120 miles north of Tati, through well watered and splendid agricultural country, about 4,000 ft. about sea level, is situated the Matabele capital, Buluwayo. It is from Tati that the imperial police, under Major Goold-Adams, with Khama's auxiliaries, are cooperating with the company's columns, a junction being intended at the Matabele capital.—*The Graphic, London.*

OCEANOGRAPHY: THE PACIFIC BED.

By RICHARD BEYNON.

THE continents of the globe approximately cover two-eighths of its surface. The waste of these great land masses covers a submarine fringe adjacent to them and equal to them in area. The remainder of the land that is beneath the waters is covered by deposits generally denominated abysmal. The subaqueous deposits which fringe the shores of the land masses inclosing the Pacific Ocean have no definite line of demarkation separating them from the deposits that strew the deeper portions of the sea bed. On the landward side the boundary is, of course, the high water mark. From this line the detritus from the land extends seaward to a distance that may be anything from sixty to three hundred miles.

The forces that assist in strewing the coastal bed of the Pacific with this land-derived matter are various. The most important, however, must be assigned to the rivers, which are undoubtedly very potent factors in removing the products of disintegration from land to sea. Fine sand and land dust are carried hundreds of miles out to sea before they are dropped to gradually settle to the bottom. The winds are far behind the rivers in the magnitude of their work in this direction. It has been estimated that our own Thames carries daily past Kingston some 1,600 tons of solid matter in a state of solution, to say nothing of suspended matter. The Ganges during the four rainy months is estimated to carry seaward a weight of solid suspended matter equal to one four-hundredth of the weight of water discharged during the same period. The final location of this floating matter depends partly upon its own character and partly upon the current force of the stream which bears it. Given an unexposed coast, a river of low velocity, and a receiving sea undisturbed by strong currents and tidal action, then the major portion of the sea-borne silt will concentrate itself into a delta at the expense of an extensive deposit over the sea bed adjacent to the river outlet. The rivers and torrents which join the Pacific on the American side are, many of them, possessed of great carrying power, which atones somewhat for the shortness of their courses. It must be remembered in this connection that experiments show that the capacity of a river for carrying down sedimentary matter varies as the sixth power of its rate of flow. Thus, in the case of two streams of equal volumes, the one flowing at the rate of two and the other at four knots, the latter will possess sixty-four times the carrying power of the other.

As might be expected, the finest particles of silt are carried farther into the Pacific than are the larger fragments, so that as the abysses of the ocean are reached, deposits from the land gradually cease. But long before they entirely disappear from the sea bed they are mixed with the organic oozes, which are the remains of the lowly organisms which, in some form or other, are so widely spread throughout the great oceans. The section of the sea floor upon which the land detritus is deposited is sometimes styled the transitional area, a name by no means inappropriate. It is the connecting link between land and sea. The waters that sweep over it are influenced very largely by tides and currents. They are, so to speak, a liquid continuation of the land, charged with its wave or river worn particles. The creatures that have their being in these waters are subjected to much the same temperature changes as we are; like us, they experience the varying gradations of the sun's light and heat. When the great ocean depths are reached all this is changed. The friendly sunlight is powerless to penetrate these abysses. The temperature is low and practically constant, being but a few degrees removed from the freezing point. The succession of night and day, the sequence of the seasons, leave no mark upon the vast undulating plains over which the icy cold water, with a motion that is hardly perceptible, ever creeps toward the equator. The sea bed covered by the shore *debris* and the water that rests upon it, is rich in life. At a depth of two to five miles plant life is almost entirely absent, nor is animal life much more abundant, the varieties being few and the individuals by no means numerous.

Terraginous deposits are those which accumulate most rapidly in the basin of the Pacific, so that the disparity between the depth of water on the platforms from which the continents rise and that over the deep recesses is ever slowly becoming greater and greater. They are commonly classed as shore deposits proper, blue mud, green mud, and red mud. The first named are the result of attrition betwixt waves and shore, but so far as the other varieties are concerned the division is somewhat arbitrary. Sediments of river origin do in many cases give blue muds, while much of the mud found adjacent to parts of the Australian and South American coasts, where there are few or no rivers, takes a distinctly green color. In the red mud the coloring matter is mainly oxide of iron, and all these sedimentary deposits must be regarded as forming in embryo the shales, sandstones, or other sedimentary rocks of future ages.

The pelagic deposits of the Pacific may be divided into two groups according as they are of organic or mineral origin. Here, again, it must be remembered that there is no definite boundary betwixt one deposit and another. All more or less overlap. That which covers the greatest area is the well known red clay. This mineral deposit would seem to be evenly deposited over the whole bed of the Pacific. The percentage, however, found in abysmal specimens varies greatly, the profuseness of other deposits in some areas being such that the red clay forms an almost inappreciable fraction of the accumulated sediment. In spite of this the red clay must be considered the most extensive of all the pelagic deposits of the Pacific, for throughout the deep sea bed lying between fifty degrees north and south latitude there are vast areas where it is practically the only covering of the sea floor. The rate at which it is deposited is much slower than the organic sediments, and in the deepest abysses it is practically unmixed with other precipitated matter.

Red clay pure and simple would seem to be principally mineral with an intermixture of the silicious remains of minute organic life. The almost impalpable mineral particles are of volcanic derivation, and as such are, of course, of land origin. Such being the case, it follows that these deposits are quantitatively greater nearer the shore, but there they form, as stated above, an almost inappreciable percentage of the sea bed deposit. The minute particles of pumice and other volcanic *debris* are so exceedingly fine that in all probability they have taken a long time, which must be reckoned by years, to perform their downward voyage from the sea surface to its bed. Microscopic particles of the oxides of iron and manganese are of frequent occurrence, and often they form a coating round any other matter which collects upon the ocean floor. It is these substances which impart to the clay much of the deep brown or red color so characteristic of this deposit. Many of the microscopic specks of iron and manganese are believed to be of other than terrestrial origin and are held to be the remains of the meteoritic matter with which our earth has been in contact.

Perhaps the most peculiar feature of the pelagic deposits of the Pacific is the abundance of remains of the larger sea organisms which have been discovered. These are thickest in the red clay area. The ear bones of cetaceans and the teeth of sharks have been dredged in great numbers, a single haul on one occasion bringing to the surface no less than 600 sharks' teeth, 100 whales' ear bones, and 50 fragments of other bones. So large an accumulation as this has brought many ingenious theories into existence. The prettiest of these is that the ruling dynasties of fishdom, the whales and their more bloodthirsty neighbors the sharks, selected certain areas of the Pacific as burial grounds. To these localities diseased or infirm fish were required to repair in order to be on hand for burial when the final call came. Hence, argue these theorists, the existence of these marine cemeteries. On the face of it such a notion is absurd. It is ludicrous to conceive of one of the shagreen coated fraternity, whose snug little patrimony in the shape of a hunting ground at the mouth of some stream or river provided him with a livelihood for which he did not have to work too hard, abandoning the scenes of his youth when old age crept on for a more precarious existence in midocean. Such a belief is not tenable. Yet many natural history fablists discovered that sharks, and whales, too, invariably dispossessed their infirm and aged relatives from spots where game was most plentiful. It was just a case, said they, of the survival of the fittest, only instead of their inhuman offspring driving them to the union, they simply ousted them to the remoter and less populous areas of midocean. There is, however, no call for the exercise of so much ingenuity. The sharks and the whales have no burial grounds, churchyard, or cemetery. Many of the bones dredged up must have lain on the sea bed for a period compared with which written history is as nothing. The teeth that are now brought to the light show, when divested of their coating of ferric or manganesian oxide, that the creature of whose prey-tearing apparatus they formed a part has long since become extinct among sea creatures. The limy skeleton has been disseminated through the ocean waters ages back, but the enamel-protected teeth defied the solvent action of the water, and thus they still abound to perplex the imaginative minds who read but superficially in the book of nature. Nearer shore, and within the area affected by the chalk-forming organisms, such ossiferous deposits would speedily become embedded in a formation of which they would form no perceptible constituent. But still they are there, in perhaps as great, if not greater, numbers than in the regions of the central Pacific, where there is practically no other sedimentary matter than the slow-forming red clay.

We have stated that the remains of silicious organisms are found mixed with the red clay of the ocean depths. Silica, it must be remembered, is practically insoluble in water, so that the microscopic organisms whose minute shells are composed of it are, so far as their skeletons are concerned, indestructible. Oozes in which the principal constituent is this silicious matter are generally denominated radiolarian, from the tiny organisms concerned in their formation. Anywhere in the central Pacific at a greater depth than 2,500 fathoms such oozes may be found.

A more important deposit than this is the ooze known as the globigerinæ, and formed from the calcareous shells of those tiny organisms. In the tropical and sub-tropical sections of the ocean, at any depth between 500 and 2,700 fathoms, this deposit may be encountered. In some areas it is practically the only sediment which lines the ocean floor, so fast comparatively is its rate of formation. The proportion of carbonate of lime in such layers varies considerably, and ranges from 40 to 95 per cent. These lime-secreting animals live at the sea surface, or at least near it, and when dead their animal portion gradually undergoes decomposition, and the tiny shell slowly sinks to the sea-bed. These calcareous shells do not accumulate at greater depths than the 2,700 fathoms mentioned above. But there is no such thing as a hard-and-fast limit to the depth at which they are found. Beyond 2,800 fathoms, however, there are but few of these shells found upon the ocean floor, though in all probability the minute creatures which secrete them are just as plentiful near the surface as they are elsewhere. The explanation is that the shells are doubtless dissolved in their passage through so much seawater. It is known that deep seawater contains more lime in a state of solution than does that at the surface, and the reason of this is not far to seek, for the decomposing organic matter insures that the seawater is charged with carbonic acid. If we wish to see what part these minute organisms have played in the past history of the earth's crust, we have only to turn to our own chalk and limestone rocks. The formation of such strata is probably going on now in the depths of the sea at much the same rate as it did in by-gone days. In a section of ocean water, one mile square by 100 fathoms in thickness, the calculation was made that the total weight of carbonate of lime existing in the form of the shells of these microscopic organisms was 16 tons.

Other organic oozes found upon the floor of the Pacific are those known as diatom and pteropod. The former is composed of the remains of minute plants called diatoms which live at or near the surface of the ocean, and secrete silica from its waters to build up their cells. When the plants die their flinty remains sink down to the sea-bed, and there assist to form a silicious deposit. The area in which the activity of these tiny rockmakers is greatest lies in the southern ocean south of the forty-fifth parallel.

The pteropod ooze differs little from the globigerina, except that it contains a great number of species of lime-secreting organisms, more especially of molluscan animals known as pteropods. This deposit is found at depths of less than 1,500 fathoms, and this is doubtless owing to the fact that the shells composing it are of a peculiarly delicate character, so that at depths at which the stouter shell of the globigerina is enabled to resist the solvent action of the seawater, the pteropod shell has entirely disappeared.

In speaking of the deposits of the Pacific it is necessary to allude to those surrounding its islands. Many of the Pacific islands are volcanic, while many others are of coralline formation. The former are generally surrounded with volcanic debris, while the submerged elevation on which the coral island is constructed is fringed with a waste heap of broken corals which have been detached from the reef above. Further seaward the coralline particles become smaller and smaller, the sand gives place to mud, the latter containing more amorphous matter than the sand, but both alike are derived from the reef and the organisms which lived either upon it or in its vicinity. In many coral muds the percentage of carbonate of lime is as high as 95, while in the neighborhood of all coral islands the sea-bed sediment well within the area of the coralline deposits shows a tolerably uniform percentage of from 2 to 3 of the remains of silicious organisms. There is one respect in which the deep-sea deposits of the Pacific differ rather materially from those of the Atlantic. In the last-named ocean there are certain areas on the north side of the line within which glacial deposits

strew the sea-bed pretty thickly. In the Pacific the conditions under which such contributions are precipitated are vastly different. The narrow Behring Strait practically closes the north Pacific to land debris from the Arctic regions. The vast icebergs which add such perils to the navigation of the north Atlantic during certain seasons are well known to be glacier born, *i. e.*, mainly of land origin. They are consequently laden with rocks, stones and smaller portions of earthy matter, which must be strewn upon the ocean floor along the southerly course taken by the slowly melting berg. In many cases, too, these bergs strand and perhaps get off again with the loss of their snout. The tongue of ice thrust in this manner into the shallow sea-bed melts in process of time, and its earthy burden is left, forced into the strata that there forms the sea bottom. The north Pacific is protected from these icy invaders. The southern section of the ocean is open to the Antarctic Ocean, but the ice which floats equatorward from this sea is vastly different to that from the North Polar Ocean. Much of it is water-born, and it therefore lacks the earthy matter which is such a feature of the glaciers that own Greenland's icy mountains as their birthplace. Trivial as the matter may seem to us at the present day, to the geologist of future ages it will be all-important. For when the Atlantic and Pacific are dry land, and the deposits that now cover the sea-bed have become vast continents, this difference in the glacial deposits will enable the students of nature's book to speculate with tolerable accuracy upon the confines of our two mightiest oceans.—*Nautical Magazine.*

ELECTRICAL ACTION OF LIGHT UPON SILVER.*

By Colonel J. WATERHOUSE, I.S.C., Assistant Surveyor-General of India.

IN my paper on "Electro-Chemical Reversals with Thio-Carbamides," read at the meeting of the Society in April, 1891, it was shown that the peculiar reversals of the photographic image produced by the addition of very minute quantities of a thio-carbamide, or sulpho-urea, to an eikonogen developer appeared to be connected with and accompanied by electro-chemical action, if not actually brought about by it. It was remarked, also, that the experiments brought forward pointed to the conclusion that, at any rate, as regards the haloid salts of silver, the formation and development of the photographic image is to a very great extent influenced by electrical action, more so, perhaps, than has generally been recognized, although the fact of photographic action being accompanied by electrical phenomena has been known since the earliest days of photography. It was suggested that a further investigation into the theory of photography based on electro-chemical laws might be of value in throwing light upon much that is now obscure and uncertain as regards the formation and development of the invisible photographic image formed by the exposure to light of silver haloid compounds.

Since that time I have given a good deal of attention to the subject, and tried several experiments in various ways with the object of ascertaining the electrical action of light, in connection with photography, on plates of pure silver immersed in various fluids as well as on dry plates and other forms of silver haloid compounds in ordinary photographic use. Also on the action of electrical currents in forming developable compounds of silver haloids similar to those formed by light, and, further, on the electrolysis of ordinary photographic developers and on the currents produced during the development of the photographic image. These observations are not yet sufficiently complete to found any sound deductions upon, but I hope to complete them later. In the meantime, I have thought that a short note on some observations I have lately made on the electrical action of light upon plain silver plates in various solutions might be of interest and form a suitable introduction to any further notes on this subject I may be able to bring before you. It does not pretend to be complete or exhaustive, and can only be considered as a contribution toward a systematic investigation of the question.

A great many observations have been made from time to time of the electrical influence of light on metals immersed in water and various saline solutions, and before going further, it seems desirable to give a brief summary of these observations, and more particularly of those relating to silver and its salts.

More than half a century ago, in 1839, Edmond Becquerel was the first to show that the electrical action accompanying the chemical changes brought about by the influence of light upon various substances, including several metals and the silver haloids, could be observed with the aid of a very delicate galvanometer. He found that this action was quite independent of any calorific radiation or heating of one electrode more than another, but was powerfully affected by the different rays of the spectrum, the greatest action being produced by the violet, indigo and blue rays, while with the green, yellow and red rays there was little or no action. Becquerel's observations are fully summarized in his work, "*La Lumiere, Ses Causes et Ses Effets*," Vol. II. To observe these effects he used a covered vessel, divided into two parts by a thin membrane. In each of the compartments he placed a plate of platinum or gold, previously made red-hot to remove all impurities, the plates being connected with the poles of a very sensitive galvanometer, and laid horizontally in the apparatus. Each compartment had a movable cover. He found that when the two compartments contained an alkaline solution, the plate exposed to the solar rays took negative electricity, while the reverse occurred if the solution were acid. With alterable metals, such as silver or brass, analogous effects were obtained, and the electrical effect could be largely increased by giving the plates a preliminary polarization by plunging them in water and then placing them in connection with the positive pole of a battery. When two silver plates were immersed in water acidulated with nitric acid, exposure to light of one plate only produced a very weak current, and the exposed plate was always positive. If the gold or platinum plates had been thoroughly cleaned, had remained in strong nitric acid, and had been made red hot, the different parts of the spectrum were almost powerless to produce electric currents. With well-cleaned silver plates, which had been heated several times, the effects were also almost *nil*, though not quite absent, and from this fact it seemed possible that when the plates were not in this state the effects produced might be due to the action of light upon corpuscles of organic matter adhering to the plates which became oxidized by the action of light, the water supplying the oxygen. If this effect did not take place and there was no alteration in the plates themselves, the light must produce a disturbance of the particles; but the former supposition seemed most probable. He found that when silver chloride, iodide or bromide, precipitated in a thin layer on sheets of platinum or gold, was exposed to light as above, the exposed plate was positive, and that the initial action was much stronger with the bromide than with the chloride, though the intensity of the currents observed was variable and depended on the thickness of the film of bromide; moreover, the electrical action was soon exhausted. With the iodide the current was almost as strong as with the chloride, but did not remain constant so long.

When plates of silver were employed, instead of platinum or gold, as a support for the haloids, the effects noted were stronger and more regular, but it was found that the direction of the current depended on the thickness of the films; with thin coatings the exposed plate was positive, and with thick coatings negative. This was markedly the case with plates of silver exposed to the vapors of iodine. With vapor of bromine the exposed silver plate was negative, the initial current, even with diffused light, was very strong, but after remaining exposed to light for some minutes, then protected from light and again exposed to its influence, it was found that the current was very weak. A film of silver chloride prepared by exposing a silver plate to the vapor of chlorine gave only a very weak effect, but plates coated with the violet sub-chloride behaved very well in these trials, and yielded for a long time results from which comparisons could be made.

On the basis of these experiments Becquerel invented his electro-chemical actinometer, which was practically a voltaic element or cell composed of two plates of very pure silver coated usually with the violet subchloride of silver and plunged into a conducting fluid composed of two parts of monohydrated sulphuric acid in 100 parts of water. The apparatus was so arranged that all light was excluded, except from an adjustable opening on one side by which one of the plates could be exposed to light while the other remained in darkness.

When diffused daylight or sunshine acted upon one of the plates, more or less deviation of the needle was observed, which remained constant so long as the light remained of the same intensity and the surface was sufficiently sensitive. If the light was shut off, the needle returned to zero, or somewhat beyond it, but soon regained its original position. If the light remained of the same intensity and the plate was again exposed, the electrical effect was the same as before, always provided that the sensibility of the plate remained the same, for which purpose the sensitive coating should be sufficiently thick. Under favorable conditions the sensibility of the instrument might be preserved for a whole day, and thus several consecutive observations might be made.

The deflections of the needle could not, however, be considered as proportional to the intensity of the chemical action exerted on the substance, and consequently to the active luminous intensity; they only showed whether this luminous intensity was greater or less in one circumstance or in another.

With this instrument Becquerel observed the effect of different rays of the spectrum on silver iodide and violet subchloride, and found that in both cases the maximum of action was in the green about D ⅘ E; but while with the chloride the action decreased on both sides of this point, and ceased at A and H, with the iodide that had already been exposed there was a second maximum in the indigo blue about G ⅓ H, and thence the action decreased to P in the ultra-violet. In neither case was any reversed action observed in the red rays, as observed with sensitive papers, but that might be due to the fact that in one case the sensitive surface was in water and in the other in air. Becquerel has not recorded any corresponding observations with silver bromide.

About 1840, Robert Hunt repeated Becquerel's experiments with many modifications, and the results he obtained (*Phil. Mag.*, XVI., 1840) completely confirmed them More careful trials with the spectrum on plates of different metals made later showed that every ray of the spectrum produces an electrical disturbance. The rays, however, at the least refrangible end produce a deflection of the needle in one direction, while the most refrangible rays set up a disturbance in an opposite direction. There are many indications of a condition analogous to polarity in the action of the prismatic rays (*Researches on Light*, p. 295). Hunt also remarks that "this action is only to be regarded as one of the evidences of chemical disturbance exciting electrical currents; yet, at the same time, it opens the question of the identity of the agent producing this disturbance and electricity."

In 1858, Grove (*Phil. Mag.*, XVI. (4), p. 426) recorded that he had succeeded in obtaining a deflection of the galvanometer needle by allowing a beam of light suddenly to impinge on a daguerreotype plate in a trough of water, the plate being connected with one pole of the galvanometer and a gridiron of silver wire in front of the plate with the other. In experiments with platinum plates he came to the conclusion that the action of light was always in the direction of the polarization current, though further experiments by Becquerel and others have shown that this is not the case.

In 1863, Pacinotti found that when pairs of plates of copper, zinc, iron or lead were immersed in solutions of certain salts of the same metals, the exposed plate was always negative, but with plates of silver immersed in a solution of nitrate of silver, the plate exposed to sunshine was positive; whereas if exposed to the rays of a petroleum lamp, or of a heated thick iron plate, it was negative, as were also the other metals (*Cimento*, XVIII., p. 363).

In 1875, Hankel published a series of observations on this subject (*Wied. Ann.*, I., 1877) in which he showed that the electrical behavior of the metals under the influence of light depended very much on the condition of their surfaces; consequently, in such observations it is necessary to consider separately each state of surface. His observations were made on copper in different states, tin, brass, zinc, platinum and silver. With regard to the latter, he records that when two plates of fairly pure silver were immersed in filtered tap water, the plate exposed to the light of white clouds was negative. When the plates had been left a day in the water, the rays of the setting sun still gave a pretty strong negative impulsion. Platinum plates coated with silver were slightly positive with white or blue light, while red light produced no effect. Silver plates coated with platinum (old plantinized silver battery plates), which were slightly negative when coupled in circuit with plain platinum, were found to be very sensitive to light, and the exposed plate was positive. With colored glasses the action was strongest under blue glass, but was also quite strong under yellow and red glasses; gaslight also produced a pretty strong deviation of the galvanometer needle, and it was found that the action under dark red and blue glasses was stronger than under a light green, which was much more transparent.

In 1878, Professor Dewar published a preliminary note on "Experiments in Electric Photometry" (*Proc. Roy. Soc.*, XXVII., 1878, p. 384), in which he dealt principally with the construction of the best form of cell for the general investigation of the electrical actions induced by light on fluid substances. He found that the list of substances that may be proved to undergo chemical decomposition by light was very extensive, some of the most active being the ferro and ferri cyanides of potassium and the nitro-prusside of sodium, tartrate of uranium and a mixture of selenious and sulphurous acids in presence of hydrochloric acid. The complete paper does not appear to have been published.

In 1876, M. Egoroff published a note (*Comptes Rendus, Acad. Franc.*, LXXXII., 1876) on a different electro-actinometer for the purpose of determining the absorption of the ultra-violet rays by different media. The instrument consisted of two Becquerel's electro-actinometers placed one above the other and arranged so that the current of one might be neutralized by the other. In some preliminary observations with iodized silver plates he found that the intensity of the current was proportional to the width of the opening through which light was admitted. It was also inversely proportional to the square of the distance of the source of light from the apparatus. An oil lamp was used. The instrument appeared to show an exact proportionality between the intensity of the light and that of the current, and its great sensitiveness and precision would enable it to be used as a very delicate photometer. In these experiments he found that the electromotive force exerted by the November sun upon oxidized silver plates through an opening 30 mm. wide was $\frac{1}{18}$ of a Daniell cell; with a petroleum lamp, at 8 in. distance, it was only 0·004 Daniell.

Dr. J. Moser afterward, in 1887, in working on Egoroff's plan, found that the photo-electric current might be greatly increased by treating the chlorized, iodized or bromized silver plates with solutions of erythrosin, benzo-purpurin and other dyes, and in sunlight he observed currents of a strength equal to half a volt (Eder's *Jahrbuch der Photographie*, etc., 1888, p. 297).

At the meeting of the British Association in 1880, Professor G. M. Minchin gave an account of his experiments on the generation of electric currents by the action of light on silver plates which were coated with emulsions of bromide, chloride, iodide and other salts of silver in gelatine and collodion, as well as with eosine, fluorescine and various aniline dyes, the object of these experiments being the solution of the problem of producing a photographic image of an object at a distance. A detailed account of these and other interesting experiments on light cells was read before the Physical Society and published in the *Philosophical Magazine* for March, 1891.

He found that when two pieces of clean silver foil attached to glass plates were coated with an emulsion of chloride of silver in collodion and immersed in distilled water containing a few grains of common salt, the plates being connected with the terminals of a Thomson's galvanometer and one of them screened from the light, on exposing the unscreened plate there was an electric current produced and the exposed plate was negative to the unexposed. The same effect was observed with plates coated with emulsions of silver bromide in water containing a little potassium bromide. When the plates were coated with iodide of silver in collodion by the wet silver bath method, the liquid being water containing a little potassium iodide, there was a reversal of the nature of the exposed plate, it being positive to the unexposed. With colored glasses in front of the exposed plates it was found that the red rays produced comparatively feeble currents, while those produced in the blue and violet rays were very great; but the directions of the current were the same for all rays. This agrees with Becquerel's observations. With plates coated with an emulsion of silver sulphide in potassic sulphate, the exposed plate was positive, the direction of the currents being the same for all rays, the strength of the current being least for the rays passing through the green glass.

With plates coated with an emulsion of silver nitrate in gelatine in a weak solution of barium nitrate the exposed plate was positive. The effect of the red rays was very small, and of the blue rays very great.

One of the most important points in Professor Minchin's observations is his discovery of the formation of an invisible developable deposit on silver plates coated with an emulsion of silver bromide, by the action of the electrical current from a single bichromate cell passing through the plates when immersed in water containing a little potassium bromide. He found (1) that the plate connected with the carbon pole, the cathode, was without the employment of any developer visibly blackened in its immersed part; (2) that no visible change took place on the other plate attached to the zinc; but when the plate was developed with an ordinary pyrogallic acid developer, its immersed portion was also blackened. These effects were entirely due to the passage of the current, and were strictly confined to those portions of the sensitive plate through which the current passed.

* Read before the Asiatic Society of Bengal.

MARECHAL DE MACMAHON.

THE last but one of the marshals of France has passed away. Marie Edme Patrick Maurice, Marechal MacMahon and Duc de Magenta, died at the Chateau de la Foret on Tuesday morning, October 17, 1893. He was born July 13, 1808. The name and genealogy of the deceased soldier recalls the old affection between the French and the Irish, which has induced many and many an Irishman to expatriate himself and to enter the military service of France. The MacMahons after playing for the supreme stake in Ireland in the time of James II., paid the penalty of the failure of the Stuarts to enjoy their own again and crossed the sea to France, where they intermarried with some of the most distinguished families of the old *noblesse*. Born in 1808, when the first empire was at the zenith of its brief but brilliant career, the young MacMahon entered at the military school of St. Cyr during the uneventful period of the Bourbon restoration. The piping times of peace were not, however, destined to last long. After taking part in the expedition to Antwerp in 1832 MacMahon became one of that band of French officers whose names have become famous through the part they played in the wild warfare against the Arabs of Algeria—warfare distinguished by the most splendid heroism in the field and the most cruel sufferings from hunger, thirst, fatigue and unhealthy climate. Among the "Africans," as they were called, MacMahon speedily made his mark; and a legend—to use the French phrase—began to form itself round his name and personality. Promotion came rapidly. Major of Chasseurs-à-pied in 1840, lieutenant-colonel of the hard-fighting adventurers of the Foreign Legion in 1842, and colonel of the 41st regiment of the Line in 1845, MacMahon in the eventful year of 1848 became a general of brigade. Old English soldiers have not forgotten the part played by MacMahon—who had succeeded Canrobert in the command of a division—in the Crimea. His success on the occasion of the storming of the Malakoff made his name known all over the world, and earned him the grand cross of the Legion of Honor, as well as that of the Bath. The French army returned from the Crimea with enormous prestige, which was destined to be further augmented by the Italian campaign in 1859, in which MacMahon's achievement at Magenta obtained him the marshal's baton and the dukedom with which Napoleon III., in imitation of his uncle, rewarded his successful generals, thereby impressing the world with the parallel which he was always seeking to maintain between the first and second empires. It would have been well for the hero of Magenta and the Malakoff if his career had been cut short at that point, for history would have recorded of him nothing but success; whereas, from that time forward, she has chronicled nothing but failures. In 1864 MacMahon was appointed Governor-General of Algeria—a difficult post, which proved too much for his modest administrative abilities.

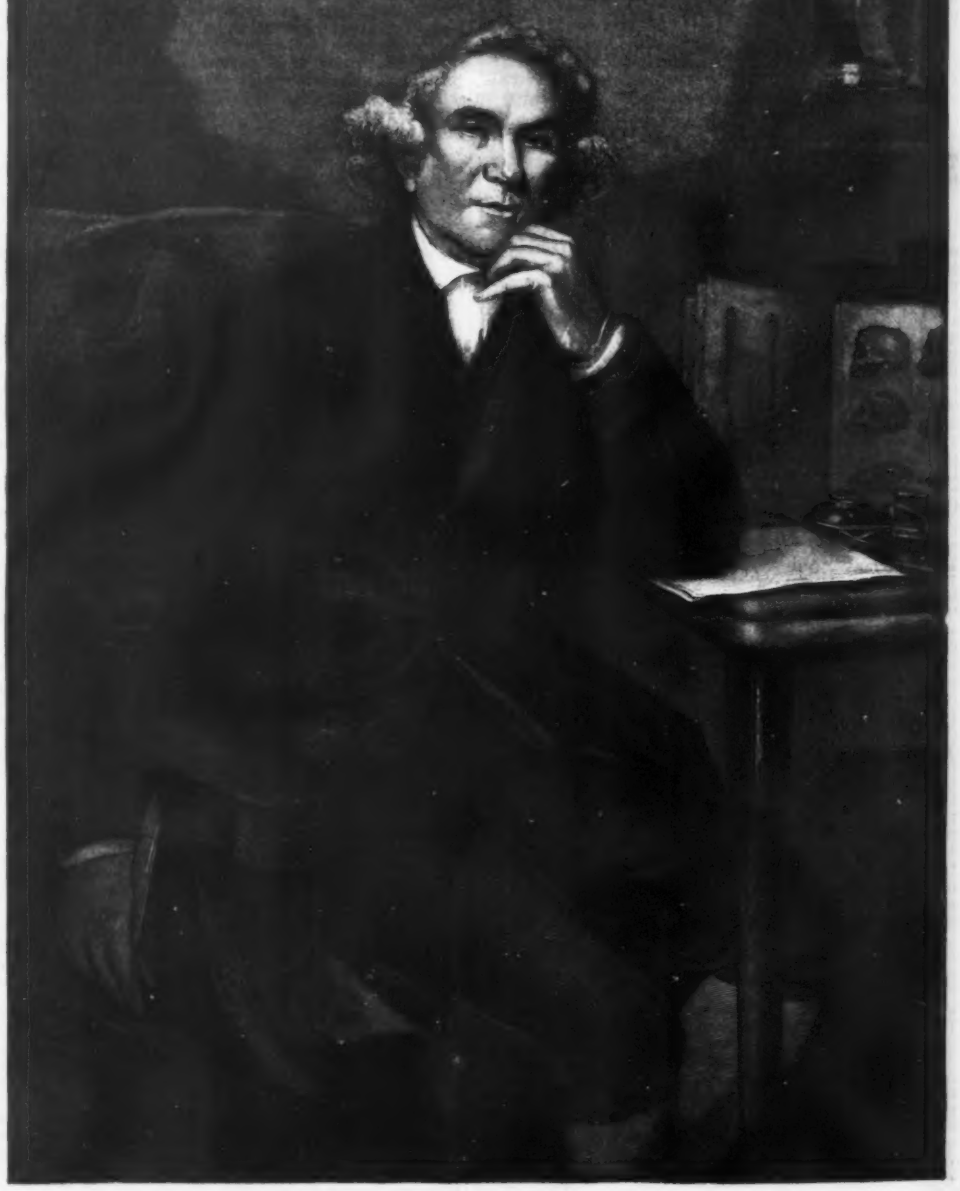
MARECHAL DE MACMAHON.

The system which he endeavored to inaugurate was merely one of the long series of failures which the French have made during more than sixty years of occupation of this great colony in Northern Africa. The declaration of war against Prussia, however, brought him back from Algeria, where Napoleon III. had intentionally kept him, out of jealousy of his popularity with the army. Great hopes, naturally enough, were entertained of MacMahon; but they were doomed to perish in the cataclysm which overwhelmed the French army in that disastrous campaign. The serious defeat inflicted upon the French at Worth by the Crown Prince of Prussia, in which, however, MacMahon was opposed by overwhelming numbers, was followed by the crowning disaster of Sedan, when he was severely wounded at an early stage of the engagement. Conveyed, wounded and a prisoner, to Germany, the Marshal returned to France in time to take command of the Army of Versailles, which recaptured Paris from the Communards, and inflicted sanguinary but well-merited punishment upon the wretches who had done their best to lay the beautiful city in ashes. After rendering valuable assistance to his country in the indispensable work of reorganizing the shattered military resources of France, the Marshal succeeded M. Thiers as president of the republic in 1873.

The story of his presidency belongs as much to the history of France as to his own. The crisis of the famous "Seize Mai," resulting as it did in the return of a republican majority to the new Chamber of Deputies, was really the death blow to the hopes of that royalist restoration which had gone so near to become an accomplished fact. The Marshal refused to yield to the pressure put upon him by the republicans to republicanize the army and the administration, and resigned the presidency. Since that time he has taken no part in public affairs. Marshal de MacMahon leaves behind him the reputation of a valiant soldier of the old school, as well as that of a loyal and gallant gentleman. Our portrait is from a photograph by E. Hautecœur, Paris.—*The Graphic.*

THE JOHN HUNTER CENTENARY.

THE centenary of the death, Oct. 16, 1793, of the most eminent of British surgeons, anatomists, and physiologists in the last century is a suitable occasion for reproducing his portrait, which was painted by Sir Joshua Reynolds, and which belongs to the Royal College of Surgeons. With this are presented views of the farmhouse in which John Hunter was born, at Long Calderwood, Kilbride, near Glasgow, and of the house at Earl's Court, then a rural suburb of London, in which he resided during the latter years of his life, together with a few relics preserved at the Royal College of Surgeons, for which institution his valuable museum was purchased by government.



JOHN HUNTER, F.R.S.

(From the picture by Sir Joshua Reynolds, at the Royal College of Surgeons.)

John Hunter, born July 14, 1728, had a brother, William Hunter, ten years older than himself, who studied medicine and surgery at Edinburgh and in London, became a lecturer on those subjects in Covent Garden and a successful practitioner, especially in midwifery; he won the favor of King George III. and Queen Charlotte, was elected a fellow of the Royal Society, and was appointed professor of anatomy at the Royal Academy. The merit and reputation of William Hunter, as a physician, accoucheur, and scientific investigator, were of the highest order, and his library and museum, bequeathed to the University of Glasgow, form a noble monument of his knowledge and industry; but his fame has perhaps been since eclipsed by that of his younger brother. It was in 1748 that John Hunter, who had been three years an apprentice to his brother-in-law, Mr. Buchanan, a cabinet maker at Glasgow, came to London to join William Hunter as assistant in the dissecting room which the latter had established two years before, for the instruction of students of anatomy. John Hunter soon became a pupil of Cheselden, then surgeon to Chelsea Hospital, and was afterward at Bartholomew's Hospital. In 1753 he entered St. Mary's Hall, Oxford, intending to take a degree which would qualify him to practice as a physician, but his university education was never completed. He seems to have soon changed his purpose, resolving to devote his whole attention to surgery and anatomy, and pursued his further studies at St. George's Hospital. Becoming a partner in his brother's school, he delivered a portion of the annual course of lectures there until his health gave way, when he procured an appointment as staff surgeon in the army, with which he served chiefly in Spain and Portugal, till the peace of 1763. On his return to England he commenced practice as a surgeon in London. His professional earnings in the first five years were scarcely enough to support him, and he formed classes of pupils, but was often embarrassed for money to defray the cost of his researches and collections of specimens. In 1767 he was elected a fellow of the Royal Society, and in the following year became surgeon to St. George's Hospital. This appointment secured his position, and during twenty-five years his fame continually increased. He held the office of inspector-general of hospitals. Among his pupils were Jenner and Everard Home; the sister of the latter became John Hunter's wife. From the time of his appointment to St. George's Hospital, the life of John Hunter was occupied with constant and laborious investigations of every branch of natural history, comparative anatomy, physiology, and pathology, in the hours he could spare from a large surgical practice.

The museum which he formed, consisting of more than ten thousand preparations, contains, in the physiological series, dissections of the organs of plants and animals, classed in two main divisions; the first illustrating the functions which serve the vital needs of the individual, such as the circulation of sap or of blood, digestion, nutrition, respiration, and locomotion; the second, those which provide for the reproduction of the species. There was also a collection of nearly a thousand skeletons, besides collections of 3,000 plants and animals, 1,300 fossils, and 2,500 pathological specimens, illustrating the processes and effects of various diseases. This museum was purchased

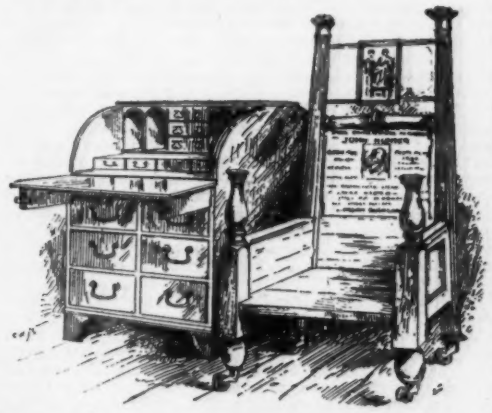
from Hunter's family for £15,000, to be presented to the Royal College of Surgeons, by whom it has been maintained and greatly augmented.

John Hunter's published writings are collected in four volumes, edited by Mr. J. F. Palmer, with a memoir by Dr. Drewry Ottley, and consist principally of treatises "on certain parts of the animal economy," on "the human teeth," on "the blood," and on "inflammation and gunshot wounds." Other notes or treatises

JOHN HUNTER'S HOUSE AT EARL'S COURT.

of his were employed, after his death, by Sir Everard Home, in essays contributed to the "Philosophical Transactions." It is probable that physiological science owes to John Hunter the earliest suggestion of many important discoveries for which credit has been given to his immediate and later successors. He was certainly, as appears from his drawings, well acquainted with the development of the embryo, and he had obtained some insight into the development of species, for he regarded monstrous formations as exhibiting a reversion to the natural type of animals lower in the scale of creation. His remarks on fossil bones prove also that he discerned the elements of paleontological inquiry. In practical surgery, also, and in pathology he has the merit of having first accurately observed the disease of inflammation of the veins, while his studies of the venereal disease, and his improvement of the operation for aneurism, were of the greatest utility to the healing art. John Hunter, as a natural philosopher, especially as a comparative zoologist, would, perhaps, have attained the fame of a precursor of Darwin if he had had more time for writing theoretical essays. He kept, at Earl's Court, a curious menagerie of all kinds of living animals, whose habits and instincts he methodically observed. If he left any notes or records of these observations among his manuscripts, they were, unhappily, neglected by his literary executors, and have been destroyed.

JOHN HUNTER'S BIRTHPLACE, AT LONG CALDERWOOD, EAST LANARKSHIRE.



ESCRITOIRE BELONGING TO JOHN HUNTER AND CHAIR MADE FROM BEDSTEAD BELONGING TO HUNTER.

JOHN HUNTER'S LANCET CASE, POCKET SCALES, AND SILVER TANKARD.

HUNTER'S LIBRARY STEPS AND CHAIR, ARRANGED FOR SHOWING SPECIMENS.

[Continued from SUPPLEMENT, No. 933, page 14916.]

THERAPEUTICAL SUPERSTITION.*

By GEORGE T. WELCH, M.D., Passaic, N. J.

WHAT pain it is to a great inventor to find that his speculations were distilling long ago in the alembic of another's brain! And yet so active have been men's minds that there are few things said, done, or conjectured, but that the spark was struck forth in immemorial days. "Eighteen very old men," said Theodore Parker, "could touch hands back to the birth of Christ," and in my researches into old books I never yet found one that did not allude to some book more ancient still, and to names of scholars of dates still beyond, whose monographs and treatises have clean mouldered away in the crypts of time. As far out from the central darkness of the Middle Ages as the seventeenth century, I find in Schroder's Chymical Dispensatory, 1669, that the physicians of his day, upon the same hypothesis that Hammond has proceeded, and Brown-Séquard before him, used the different animal glands and tissues in medicine for the cure of distempers in corresponding parts in man. The work of Culpepper, 1653, gives some recipes for preparing fox lungs into a loloch for the cure of asthmas and inflammation of the lungs, and he recommends duck livers as being exceedingly strengthening to the liver. But Schroder, whom Cullen respectfully criticises as an authority in his day, is more elaborate in his treatise and quotes from Crato, Baubin, Jordan, Libavius, Crollus and others, now no longer obtainable, as I am told by librarians whom I have consulted. In his fifth book, Zoology, he treats of that "Part of Pharmacy that shews what Medicines are to be taken from Animals," and he gives, with anxious concern, explicit directions for the choice of animals that "have no diseased dispositions," and orders that they shall be killed by external violence to the end that "the medicamental substances of everything fit to act shall be without diseases and full of wholesome tinctures."

For the relief of impotence in the man, or sterility in women, he recommends the testes of the boar, and quotes Schwenkfield as an authority for the use of the same glands from the stag for a similar purpose. For diseases of the liver he urges the use of the liver of the calf, the hare, the wolf and the fox. The spleen of the calf and of the fox, he asserts, will cure diseases of the spleen, and lung diseases are benefited by medicines made from the lungs of the fox. Drachm doses of the powder of wolf's intestines would cure colics. The dried uterus of the hare "taken after the terms would help conception." For weakness of the bladder he directs a sheep's or goat's bladder to be calcined and given.

In the first and second books of his Dispensatory he gives at great length the methods to be employed in preparing these animal drugs for exhibition.

But more daring than our modern therapeutists, he deals with the body of man himself, as being so much good material for medicine that it should not be wasted on a final resurrection, but should be raised up in the living body of those who languish. The physicians of the day employed in their practice the following parts and excrements of the living body of man: The hair, nails, saliva, perspiration, milk, secundines, spermatic fluid, the blood, and things unmentionable. And from the dead body, the flesh, the skin, the oil, the bones, the brain, gall and heart. The hair was said to breed hair, and a distilled liquor was made thereof, with honey, for the purpose. The sweat, seeing that it exuded from the glands, was good against scrofula. The secundines, calcined and given in southernwood water, cast out moles and children dead. From the semen was made a magnetic mummy to cause love, and, as Schroder quaintly puts it, "Paracelsus makes his little man thereof." The blood, drunk hot, cured epilepsy. Applied to nose or skin it stopped hemorrhages. An oil extracted from it cured consumptions. A balsam was made of it to cure the gout. Dried gently and impregnated with spirit of lemons or vitriol, and made into troches with myrrh, it cured carbuncles.

The brain of a young man under twenty-four, who had died of violence, was taken by the chemist, with all its membranes, arteries, veins and nerves, and beaten in a mortar; to this was added the waters of tile flowers, piony, bettony, black cherries, lavender, lilly-convals, until it was covered four inches. After standing awhile it was distilled and became "a brave antepileptick." Salt added to the brain, and the whole distilled in a glass retort in the sand, was used to strengthen the living brain. He tells us "if we would have more medicines made from man, we should read the particular Tractate of Becker, in quarto."

But Dr. Shoemaker, of Philadelphia, less aspiring, could, if he would, cure anything with kola nut. Kola nut, chemically considered, contains about 2·3 per cent. of an alkaloid analogous to theine or caffeine, 0·023 per cent. of theobromine, together with tannic acid, sugar, albumen, cellulose, starch, fat, and fixed salts. Mild enough, but with this Shoemaker had excellent results in migraine, the acute pain soon subsiding, the vomiting was relieved, and the patient entering upon a convalescence slow as usual, but more rapid than he had expected. (Now migraine naturally takes an increasing course until vomiting occurs, shortly after which the patient is relieved and usually falls into a sleep, from which he awakes free from the headache.)

In the case of a girl of sixteen, whose condition was due to excessive school tasks in a hot, ill-ventilated room, without outdoor exercise, kola brought about an entire change. Under its use, and withdrawal from school, she soon regained a good appetite, her headache left, and she became able to sleep at night, and, as he delicately puts it, "she now has the courage to pass a certain portion of every day in the open air." (All of which would have occurred on the girl's withdrawal from school if the kola nut had been still in Africa.)

But he did not pause after these triumphs. He got good results from kola in melancholia, neuralgia, ulnar neuritis, spurious locomotor ataxia, gastro-intestinal irritability, irregular heart, tuberculosis, dyspepsia, gastro-enteritis, renal irritation—in fact, he had a whole Philadelphia drug store in a kola nut! He even cured boils with it, after he had first evacuated the pus! If I have done this unconscious humorist wrong, I can but recommend kola nut to his attention.

A sturdier faith never prompted any man to hug the iron that wounded him than appears in Dr. J. S. Whitmire, of Metamora, Ill., who for the cure of cerebral rheumatism took black cohosh, iron, quinine, strychnia and iodide of potash every four hours, together with phosphate of soda and tincture of digitalis every six hours. In one month he had taken 180 drachms of cohosh, three grains of strychnia, 180 grains of quinine, three drachms of iron, nearly two pounds of the phosphate of soda, besides his digitalis and iodide of potash. He then went to bed and changed his

* Address of the president, read before the New Jersey State Medical Society, at its meeting at Asbury Park, in June, 1893. From the transactions of the society.

drug diet to ergot, gelsemium, hyo scyamus and citrate of potash. At the end of ten days, having got no relief, he was put on extract of manaca, citrate of potash, strychnia, quinine, iron, and cactus. Being no better at the end of fifteen days, ergot was added and citrate of lithium. In two weeks more he was convalescent, and at last accounts he was tapering off on iron, strychnia, quinine, and hydriodic acid. Here, evidently, was a man who had nursed himself on poisons from his infancy, and in his cheerful old age he could have lain down among vipers and have defied the Borgias.

I might quote largely from minor sources—of the New York young man who gives continued doses of citrate of potash, sweet spirits of niter, acetate of ammonia and infusion of digitalis to a man who has not urinated in ten days, and at length, under the influence of a consultant, introduces a catheter for the first time, and finding no urine, changes his therapeutic tactics; of the practitioner who gives to a lady in Chicago, for follicular tonsilitis, within an hour, ten drops of tincture of belladonna, three drops of tincture of aconite, and two five-grain doses of antipyrin, and then, because the patient declared herself morbidly susceptible to the influence of quinine and begged that he should not give that to her, too, he proceeds to order a morning dose of it. Hastily summoned at 8 A. M., he as hastily concludes that the belladonna rash has been caused by his one grain of quinine. For no apparent reason, except for psychical purposes, he now gives her ten drops of tincture of nux vomica and goes home to exploit his feat in a medical journal. But I shall refrain from further illustration, only observing that this sort of dosing is going on on all sides of us.

For, from times immemorial men have believed in some preternatural power in drugs; even the occult sciences have been invoked to assist in clouding any process of reasoning on their qualities. Every this or that was under the dominion of some planet, which infused into it the virtues or vices of the heathen god under which it flourished. But, whatever the drug, it had its inevitable rise and decline. As thus, from Culpepper, 1653, of the Amara Dulcis: "It is under the planet Mercury, and a notable herb of his also, if it be rightly gathered under his influence. It is excellently good to remove witchcraft, both in men and beasts, as also all sudden diseases whatsoever. Being tied round about the neck, it is one of the most admirable remedies for vertigo or dizziness in the head; and that is the reason (as Tragus saith) the people in Germany commonly hang it about their cattle's necks when they fear any such evil hath betided them. Take notice it is a mercurial herb, and therefore of very subtle parts, as indeed all mercurial plants are." As far on as 1815 I find records of the esteem in which therapeutists held the amara dulcis. It would "remove felons, open obstructions of the liver and spleen, help difficult breathing, bruises and falls, and remove congealed blood in any part of the body, besides being useful in yellow jaundice, black jaundice and dropsy."

At the close of the nineteenth century we are too ennuied to smile at the myths of ancient theology, and the god Mercury has lost his grip on the dulcimara, but it is still recorded in our therapeutics as a remedy "for cutaneous eruptions, for chronic muscular rheumatism, chronic bronchitis, whooping cough, and other chronic pulmonary affections, but," it is added, "it must be long continued to produce curative effects." Many patient drug swallowers must have believed themselves in process of time to have been cured by this drug of their chronic invalidism, to the sedate gratification of the long-winded physicians who prescribed it. But, note you, in the seventeenth and eighteenth centuries it cured sudden diseases, while for seventy-five years back it has only been good for chronic diseases, and now it is rarely given, so low has its popularity waned. And in recent years Dr. John Harley laboriously experimented upon man with its expressed juice and tinctures, in small doses and in large, without any appreciable physiological effect whatever.

Would that as much could be said of many another drug that is wont to be used in season and out of season, for some of them in unguarded hands exert as desperate effects as the diseases they are reported to cure. The largely increased use of ergot in uterine disorders, and its long continuance in special cases, must bring about its physiological effects in time. A lady who came under my care had taken the fluid extract in drachm doses on certain days in each month for two or three years, under the advice of a physician in a neighboring city, until she at length had feeble digestion, impaired vision, menorrhagia, increasing languor, slow pulse and respiration, and an abnormally low temperature. When the drug was prohibited she gradually recovered, during as many years, from its deplorable effects.

How many physicians know anything of the natural course of most diseases except by hearsay? How many have had the courage to observe for themselves while sternly combating the seductive opportunity of prescribing a variety of unnecessary medicines? Most diseases, as they are met in practice, are so overlaid, disguised and their symptoms colored and mingled with the effects of drugs that have been administered, that only a mongrel type is known to the profession. The skilled and philosophical consultant views the case askant until he inquires what drugs have been prescribed.

Quinine, though fallen from its high estate, and passing into the hands of the laity as an universal remedy, is still given frequently by the profession for a variety of disorders. It is given promptly, largely and even hysterically in congestive intermittents, but its physiological effect is to cause the face to become suffused, the pupils dilated, the pulse accelerated, with coma and stertorous breathing. How shall we divine between these lethal effects of disease and drug? Few recover from the congestive intermittent and few recover from poisonous doses of quinine.

How often is gelsemium prescribed in neuralgias, congestions of the brain, and sthenic febrile diseases; and yet even minute doses of this drug have caused alarming symptoms—the face becomes congested, the pupils dilated, the respiration slow, the brain dizzy, and death not seldom follows.

Copaiba is a favorite remedy with most physicians in vesical catarrh, but the continued use of copaiba renders the urine darker and turbid, and irritates the bladder, causing micturition and sometimes hæmaturia.

Typhoid fever persists, ferocious, undeviating, in spite of the fifty-odd drugs prescribed by the variety of physicians in attendance on a given number of cases. Some of the patients lie muttering under the spell of alcohol, some in extreme hebitude of mind lie dazed under the swooning influence of enormous doses of quinine, some lie weltering in the perspiration induced by antipyrin, but all who do not die beforetimes continue to be prey of the riotous fiend just the same as if no powerful drug had been administered. And yet who dare aver that active medication does not imperil the sick man's chances?

Think of the saturnalia of drugs that has been administered for the relief and cure of hysteria! Ether, amber, amyl, asafœtida, camphor, castor, dracontium, galega, musk, narcissus, succini, parthenium, lead, bromides, primula, ruta, houseleek, mustard, rosemary, sumbul, tansy, linden and thirty more. In the main all useless, for where isolation, psychic treatment, hydrotherapy, mechanotherapy, and perhaps electrotherapy, fail, outside of the valerianates and three or four other drugs, the whole host beside but aggravate the paroxysms. The better the diagnostician, the simpler the prescription. The physician, confused by the disease, defends himself with a confusion of drugs. The less confidence he has in himself, the larger the army does the general gather about him, desiring to crush by numbers where skill cannot avail.

There is a disease that ravages the earth and many a plumed knight has gone forth to conquer it, and has been himself conquered in turn. It selects its victims in hovels and in palaces, and gloats equally upon the beggar, the prince, the dullard, the artist and the poet, the lady with the camellias and the sewing girl in her garret. Its stealthy tread is not only in country byways, but it walks unseen in the populous mart. It destroys more lives than any other disease, not excluding the pestilence of cholera. Like that dread Angel of the Judgment, it enters all families, chooses, and is gone. So softly has it stolen that not even the parent is aware, and the solicitous lover sees only a more ethereal beauty in the face that is soon to become but a memory in his soul. Her face is flushed with kindlings of eternity, and her eyes grow large and lustrous and fixed in their pathos, as though she held reveries with unseen bands. So rapt is she that she feels not the cruel fangs upon her vitals, and were it not for the low cough that betrays the demon at his sacrificial feast, we, too, should be deluded into thinking that the tuberculosis had abandoned his victim.

We try a hundred schemes to balk him and to rout him from the field. Iodoform, aniline, thymol, ozone, corrosive sublimate, hydrofluoric acid, inhalations of carbolic acid, creosote, iodine, eucalyptol, turpentine, sulphurous acid, cholorine, sulphureted hydrogen; intrapulmonary injections of iodol, camphor-carbolate, naphthol, guaiacol; the introduction of the bacterium termo to war upon its natural foe, the bacillus tuberculosis; Liebrich's injections of cantharidinate of potash; subcutaneous injections of goat's blood, dog's serum; Koch's tuberculin and Brown-Séquard's fluid. (*Shrady.*) But the end is the same. Unless we resort to the ameliorating influences of climate, after all is done, we have tortured in vain.

I am aware that there are members of the profession who frequently give medicine, not so much from a belief that the patient's disease demands it as from an astute sense of the fine moral effect it has for their own benefit, on the man's friends. There are people who would be clamorously dissatisfied if a relative with an incurable disease should not be well dosed on his descent; very much after the fashion of staid old sectarians in out-of-the-way neighborhoods, who would be scandalized if one should go to heaven without benefit of clergy. And then, too, it is a convenient masque to a perplexed spirit to be industriously giving something when the case is not understood. The doctor's dignity of knowledge is not questioned—he is hard at work dosing the obstinate sick man—all must be right! "When I have a case I do not understand," confessed an old New York professor, "I give iodide of potash."

If the souls of civilized men on their last journey were suddenly rehabilitated in flesh and marched before skillful judges, it could be told in large measure to what doctors these one-time patients had belonged. One drove would be found branded with tincture of iodine wherever there had been a swelling or a pain. Some would have been snipped in their noses by the perfunctory laryngologist. Here would come a platoon wearing plasters; another sopped with poultices; a third would have been blistered most cruelly by the inexorable quidnuncs that attended them. Drunkards, with skins stabbed thick with Keeley's motors, would go reeling by. Women without ovaries. Troops of sad wretches slain by fever, their stomachs corroded with a diversity of drugs. Hospital patients yet swathed in bandages, from experimental operations on hopeless diseases. Epileptics, hideous from bromism. Paralytics, yet quivering and gyrating, scarce escaped from the electrician. The wan victims of phthisis eloping in a mist of sprays by day and pursued by hypodermic spearmen at night.

For, after all these interminable centuries of dosing and the ultimate skill arrived at in the profession in the selection and application of drugs, there is no difference in the mortality rate of most diseases from what it formerly was. The death rate for New York city in 1892 was 24; and during the week ending April 1, of the current year, it was 33·2. And for the year ending June 30, 1892, it was, in cities of over 5,000 population in New Jersey, 24·81 per thousand. In an estimated city population of 870,985, there died below twenty years of age, 11,217 individuals, or one-seventieth of the entire population.

Surely, here was the strongest incentive of our art to rescue the bud and promise of the race, and I doubt not but that physicians were zealous and apothecaries calculated as they compounded, while the cold, pathetic Azrael lingered, but drugs could not stay this crusade to the tomb. And upon an individual analysis of the fatal diseases in the State for the year ending June 30, as aforesaid, I find that 1,008 died of scarlet fever, 1,776 of diphtheria and croup, 3,575 of consumption, 5,187 of acute lung diseases, 2,242 of brain and nervous diseases of children, 2,457 of adult brain and spinal diseases, and 1,625 of digestive and intestinal diseases. And the number of deaths from the chief preventable diseases was 11,720. Altogether there died 32,685 out of a population of 1,511,653, or, in other words, about one forty-sixth of the entire population died last year. If it were not for the foreign influx, where would New Jersey be in less than a generation, for the deaths exceeded the births by 2,058, in spite of the pharmacopœia?

But if this prodding stirs some saturnine brother to resentment, and he cries out testily: "What, then, have drugs done no good? Are they all equally fallacious and dangerous? How are we going to practice medicine without them?" I must return that you have a very inferior idea of the profession, indeed, if doctors are only to be pill venders. That drugs have done good when wisely applied goes without question. We know that opium assuages pain, the salicylates conquer rheumatism, phenacetin eases headache, pepsine assists digestion, and that men in all the diseases have been comforted by the apothecary's art. But the mortuary lists of the board of health can furnish no monument to the living. It was Dr. Billings' conclusion in his lecture on Vital and Medical Statistics, in 1889, that "although the expectation of life is greater, yet this is only true of the earlier ages. After a man reaches twenty, his expectation of life is less than it was fifty years ago, for the reason that more persons of feeble constitution are now nursed to manhood. The decrease in the general mortality is due to better care of infants and the prevention of contagious disease. So far as statistics show, it does not appear that there is any difference in the mortality rate of most infectious diseases from what it used to be. Or, if there is any difference, it is one which may be attributed to the special character of the epidemic, or the age and constitution of the people."

This being true, what are we going to do about it? The lives of the world are submitted into our hands. We have drugged the populace well and they have not profited by it. Like great magicians, we have juggled with drugs and have professed to cast out diseases with pellets and fumigation, but we have not assumed the sublimer attitude of striking at causes. Are we to be like a swarm of lawyers and churchmen, forever following precedent—invited forward by great enterprises, but plucked backward by ghostly hands? Here and there a lonely reformer appears, but there is no unanimity of the profession. The people are apathetic because they have not been instructed. Governments are deaf because we ourselves have never been impressive.

In those ideal commonwealths, Plato's Republic, Sir Thomas More's Utopia, Bacon's New Atlantis, Campenella's City of the Sun, the art of medicine was given an inferior place, while the lawmaker was exalted to the chief station. What a botch the lawmaker has made in real life may be read in the uneasiness of all lands. But there is a growing anticipation as to the exalted mission of our profession which is not confined to race or creed.

Whether the rise and fall of great civilizations is like the lifting and subsiding of monster waves where all at length becomes a dead, smooth sea, and where at best only a certain exaggerated undulation under the stress of fugitive storms is possible, or whether mankind, like a race of Titans, sometimes descends into hollows and caverns or camps on the edges of deserts for an age, while it renews its strength for fresh encounters, and climbs again a higher range and wrests the secrets of nature from the taciturn lips of rocks and under the cold stars wrestles with the jealous angel of the Lord, like Jacob of old, and holding fast to the divinity conquers its blessing, time is yet too young for us to tell.

But if we might indulge in lofty anticipations, which the progress of this century would seem to justify, we might in our own particular art conjecture that the day will come when physicians, as a body of public men, will be the true generals of the commonwealth. To them will be consigned the preservation of the nation, the fighting and eradicating of the microscopic enemies that menace more lives and destroy more victims than all the standing armies of the world. And where a few thousands are now grudgingly doled to the science that seeks to foster the lives of men, while millions are voted annually to the art that is trained to destroy, the scale will be reversed and the public purse will be opened with alacrity to to the aid of the enterprises of the guardians of the race, while the army will be cut to the smallest stipend.

No one disputes now the right of the state to conserve the public health by establishing quarantines, hospitals, asylums, the regulating of travel and commerce from ports of infection, and the general jurisdiction in sanitary affairs. It is a function that will in time assume vast proportions, and must come under the immediate control of the physicians of the commonwealth.

Under such a regime we may expect that these officers of the state will order the affairs of the citizens so that no man shall live for private greed, but, as in ancient Sparta, each man shall conclude that he was born not for himself, but for his country.

And under all their labors to eradicate infectious diseases, to enlighten the people in sanitary living; their removal of the tuberculous, the asthmatic, the rheumatic, to proper climates; their modeling of tenements, inspection of food, regulating of marriage, these graver minds will read that part of our literature with amused contempt and pity, where learned societies waste their time in disclosures and debates as to the rival claims of this or that drug, or combinations of drugs, in the cure or relief of yellow fever, diphtheria, scarlatina, typhoid fever and cholera, instead of striking at the root of these scourges, and with an overwhelming diction forcing the public conscience to the only sensible remedy—the banishing of them altogether from the face of the earth.

THE meat of the English walnut is almost a copy of the human brain, plums and black cherries like the human eye, almonds like the human nose, and an opened oyster and shell a perfect likeness of the human ear.

[Continued from SUPPLEMENT, No. 933, page 14915.]

PILOCARPINE: ITS PHYSIOLOGICAL ACTION AND THERAPEUTIC USES. WITH EXHIBITION OF SPECIMENS SHOWING CHANGE IN THE COLOR OF THE HAIR.*

By D. W. PRENTISS, M.D., Washington, D. C.

WE consider next the change in the color of the hair.

One case I have above referred to.

In another, a case of diphtheria in a very light-haired child, specimens taken before and after treatment show a decided change for the darker; but after a time the color appeared to fade. In this case the drug was only administered a few days.

A third case was reported in a paper read by myself before the American Medical Association, June, 1889, which I draw upon largely for the following facts:

Mrs. L., aged seventy-two years, suffering from Bright's disease, contracted kidney. Hair and eyebrows had been snow white for twenty years. Suffered greatly from itching of the skin, due to the uræmia of the kidney disease. Skin harsh and dry. For this symptom fluid extract of jaborandi was prescribed, with the effect of relieving the itching. It was taken in doses of 20 or 30 drops, several times a day, from October, 1886, to February, 1888.

During the fall of 1887 it was noticed by the nurse that the eyebrows were growing darker, and that the hair of the head was darker in patches. These patches and the eyebrows continued to become darker, until at the time of her death they were quite black, the black tufts on the head presenting a very curious appearance among the silver-white hair surrounding them. A new growth of black hair also appeared on the scalp under the old hair.

These are the only cases thus far recorded in which pilocarpine has been supposed to change the color of the hair.

In 1879, Dr. G. Schmitz (*Berliner Klinische Wochenschrift*, No. 4, 1879; *Medical Bulletin*, Philadelphia, 1882), of Cologne, reported two cases in which pilocarpine stimulated the growth of the hair in alopecia. One patient, aged sixty, completely bald. Pilocarpine subcutaneously for disease of the eye. After three injections within a fortnight the head became covered with a thick down, which grew rapidly, so that in four months no trace of the baldness was left. No mention is made of the color.

In the second case the patient, aged thirty-four, had a bald patch on top of the head the size of a playing card. Total restoration of the hair after two injections in a short time.

Scholler (*Klebs' Archiv.*, 1879) tells of similar results in animals in which alopecia had been produced by injections of bacteria.

Oscar Simon (*Berliner Klinische Wochenschrift*, 1879) relates the case of a woman, aged thirty. General alopecia—head, eyebrows, eyelashes, axillæ, and pudenda. In a few weeks, after twenty injections of pilocarpine, the lanugo of the whole body was restored. In other cases so treated there was no effect whatever.

Prof. Pick (*Vierteljahrschrift fur Dermat. und Syphil.*, 1880) relates the case of a man who was afflicted with alopecia areolata. Two weeks after pilocarpine injections followed a fine colorless lanugo, and in twelve weeks restoration of the hair.

Ten cases of alopecia pityrodes: favorable results from same treatment. Color of hair not mentioned.

Landesberg (*Medical Bulletin*, Philadelphia, 1882), of Philadelphia, says that in more than one hundred cases of eye disease treated by pilocarpine he observed no effect whatever upon the growth of the hair. Dose and mode of administration not mentioned.

In 1882, Julius Pohlman, of Buffalo, experimented on white rabbits by hypodermic injections of pilocarpine. The dose used was large, 1 grain three times a day. No change in color was noted in pure white rabbits. In party-colored animals—white and brown—in one a brown spot on back of head deepened and spread to a remarkable degree down the back and sides of the animal to the legs. In other individuals no change was noticed. Post mortems on these animals showed enlarged spleen and altered suprarenal capsules.

The question of change of color of the hair is an interesting one, both from a physiological point of view and from the practical one of pathology.

The physiological aspect embraces the question of how a change of color takes place—whether in existing hairs or produced by shedding of the hair and a new growth taking its place of a different color.

It has been doubted by good authority—Hebra and Kaposi—if the hair after being once developed can change except by a very gradual process. This doubt is based upon the theory that the hair has no vascular or nerve connection with the general system, and must, therefore, be independent of nervous or systemic influence. This position is however not tenable. The clinical evidence is positive that the hair does change color under systemic influences, sometimes gradually and sometimes suddenly.

We hear frequently of the hair turning white in a night from violent emotions, as fright, great grief, or great joy, and it has come to be a method of expressing extreme emotion to say, "It was enough to turn one's hair white."

I say it is not an uncommon thing to see mention of such cases in popular literature, but well-authenticated cases are not so often found. It is recorded in history that the hair of Marie Antoinette and Mary Queen of Scots became white suddenly from the horrors to which they were subjected.

A short time since, in conversation with an eminent microscopist and pathologist,† I asked how he would explain, from the basis of minute anatomy, the sudden change in color of the hair. He replied that he did not explain it; that he did not believe it happened; that the reported cases were not authenticated. He further said that, from the structure of the hair and its relation to the skin, he considered it impossible.

Duhring (third edition) is authority for the statement that Hebra and Kaposi discredit sudden canities. There is, nevertheless, no doubt of the fact that such change does sometimes occur, and to set the matter definitely at rest, I looked up the subject in the library of the surgeon-general's office. The following are some of the references found:

Dr. Wm. P. Dewees ("Phila. Med. Mus.," 1807, vol. iii., p. 219), of Philadelphia, reports a case of puerperal convulsions under his care. From 10 A. M. to 4 P. M. fifty ounces of blood were taken. Between the times of D. Dewees' visits—*not more than an hour*—the hair anterior to the coronal suture turned white. The next day it was less light, and in four or five days was nearly its natural color.

He also reports two cases of sudden blanching from fright.

Dr. Robert Fowler (London *Lancet*, 1853, p. 556) reports the case of a girl sixteen years of age, apparently in good health, hair black; found one morning in combing her hair, that a strip the whole length of the back hair was white, starting from a surface two inches square around the occipital protuberance. Two weeks later she had patches of ephelis over the whole body.

In the *Canada Journal of Medical Science*, 1882, p. 113, is reported a case of sudden canities due to business worry. *Microscope showed a great many air vesicles both in the medullary substance and between the medullary and cortical substances.*

Dr. Graves says most authors are of the opinion that the hair, once formed, is independent of the organism, with which opinion he disagrees, instancing *Plica Polonica* as opposed to such a theory. He states five cases sustaining his views. (See *Dublin Quarterly Journal of Med. Sci.*, 1847.)

In the *Boston Med. and Surg. Journ.*, 1851, is reported a case of a man thirty years old, hair scared white in a day by a grizzly bear. Was sick in a mining camp, was left alone and fell asleep. On waking found a grizzly bear standing over him.

A second case. Man of twenty-three years was gambling in California. Placed his entire savings of eleven hundred dollars on the turn of a card; was under tremendous nervous excitement while the cards were being dealt. He won. The next day his hair was perfectly white.

In the same article is the statement that the jet-black hair of the Pacific islanders does not turn gray gradually; but when it does turn it is sudden, usually the result of fright or sudden emotions.

The following cases are of change of color from white to black:

Dr. Bruley (*Boston Med. and Surg. Journ.*, 1852, p. 406), physician to the Fontainebleau, reported to the Societe Medicale, Paris, in 1798, the case of a woman, sixty years old, whose hair, naturally white and transparent as glass, became jet black four days before her death (phthisis). On examination after death the bulbs of the black hairs were of immense size and engorged with dark pigment. The roots of white hairs that remained were dried up and two-thirds smaller in size (Wilson "Skin Diseases," p. 377).

Dr. Alanson Abbe (*loc. cit.*) mentions the case of Dr. Capen, who had become gray; but, on recovery from disease, his hair became quite dark.

In the *St. Louis Med. and Surg. Journ.*, 1845, p. 310, there is reported the case of an old man, eighty-one years of age, robust and hale. Hair, from being perfectly white, became black; same of the beard. This man also presented the phenomena of second sight; could read readily without glasses.

The text books on skin diseases also mention cases. Several cases of sudden canities are referred to in Ziemssen.

Brown-Sequard, in his own person, noticed one day a white hair in his beard where there was none the day previous. He pulled it out and the next day others appeared.

This was observed repeatedly, and there was no doubt that the hair in its entire length turned white in one night. Under the microscope these white hairs showed small *air bubbles in place of the normal pigment.*

In a case of hemiplegia, the hair became white on the paralyzed side. The same has been reported in cases of neuralgia.

Other anomalous cases have been noted where the hair became white in patches, and where individual hairs have been seen alternately white and black at different stages of its growth, to which condition Karsh and Landois have given the name of "ringed hair," and ascribed it to an intermittent trophic disease affecting the hair follicle.

Wilson mentions a case where the hair was gray in winter and regained its normal color in summer.

Alibert (*loc. cit.*) and Beizel relate cases of women with blonde hair which all came out after severe fever, and when new hair grew it was black. Alibert also relates the case of a young man who lost brown hair during illness and that which replaced it was red. In the case of an epileptic girl of idiotic type, with alternating phases of stupidity and excitement, during the stage of stupidity the hair was blonde, during excitement it was red. This change of color took place in two or three days, the change always beginning *at the end of the hairs.* Pale hairs showed an *increased number of air spaces.*

It has been frequently observed that when the hair changes color gradually, the change begins in the end and extends toward the bulb.

In conversation with an eminent ornithologist* on the change of color in the plumage of birds, he said: "I have lately been watching hairs in my mustache turn gray, and it always begins at the ends and extends to the roots."

Speaking on the subject with a lady (the one who furnished the specimens here shown), she mentioned the case of the physician who attended her at the seashore some years ago. The doctor's hair was long and quite gray. One day he came in to see her after having his hair cut, and she was surprised to notice that the gray hair had given place to black. Examination showed that his hair toward the ends had been white, and that nearer to the skin black. The white portion had been removed by the cutting. This phenomenon may frequently be noticed, attention having once been called to it.

The cases here collected are only a few in comparison to what might be found, but they are sufficient to prove beyond all reasonable doubt that the hair does suddenly change color under certain circumstances, and that the change takes place in existing hairs.

Analogous to changes in the color of the hair in man are the changes which occur in the lower animals. In animals and birds such changes are often periodical, as in their summer and winter coats. This occurs to a very marked degree in a great many species. Thus, the ermine in summer is dark brown, in winter pure white, with only the black tip to the tail.

Among birds the ptarmigan is white in winter and brown in summer. So with our familiar bobolink, yellow in fall, in spring black and buff.

As to the question whether, in birds and animals, this change takes place in individual feathers and hairs, or whether all the old plumage and fur is shed by moulting, recent investigations favor the view that it is due to both. Dr. Elliott Coues ("Fur-Bearing Animals") says it may be either or both. Mr. Robert Ridgway (Smithsonian Institution) inclines to the opinion that in birds it is accomplished by moulting.

Dr. Louis Stejneger (Smithsonian Institution) was formerly of the same opinion, but recent studies have inclined him to the belief that there is also a change in the color of existing feathers. He was led to this change of belief by a critical study of the changes in color of the black and white fly-catcher of Europe, and especially from an examination of a series of twenty-seven specimens of the narcissus fly-catcher (*Xanthophygalia narcissina*) of Japan. His studies in full appear in the "Proceedings of the United States National Museum, 1889."

Dr. C. Hart Merriam, Ornithologist of the Agricultural Department, in a letter dated June 12, 1889, says: "The change from fall to spring plumage in birds is due to moult, without exception, as far as I am aware. In the case of mammals the matter is now in dispute. Probably in the majority of cases it is due in part to moult and in part to actual change in the color of existing hairs. . . . The change in color from immaturity to maturity is always due to the growth of new hairs or feathers."

That the change in birds and mammals is due, in part at least, to change of existing coats seems established. Sometimes this change is almost sudden, as where the change of season is very abrupt. In such case, of course, there would not be time for the growth of new hair or plumage.

In the golden plover (*Charadrius dominicus*) the black belly of summer changes to white in winter. While this change is taking place, individual feathers, part black and part white, may be seen.

In Bonaparte's gull, a common gull of our coast (*Larus Philadelphia*), the black of the head of summer changes to white in winter, principally by change in color of existing feathers (Ridgway).

Another interesting feature of this question, as bearing on the change in the color of the hair by drugs, is the influence of certain substances administered as food, in changing the color of tissues in some of the lower orders.

In orange canaries it has come to be an established fact that, by feeding the parent birds with a certain kind of food, the active ingredient of which is cayenne pepper, the offspring will be of an orange color, and orange-colored canaries may be seen in the stores of most bird fanciers. A food for producing orange canaries is extensively advertised by a bird dealer in Baltimore (Bishop). It is reported that the Indians of the Amazon cause green parrots to change to yellow and red by feeding them upon the fat of a certain fish allied to the shad (Wallace's "Amazon").

Dr. Merriam, in the letter previously quoted, says: "It is well known that food affects the color in birds. Red purple finches and pine grosbeaks invariably turn yellow when caged. This is due undoubtedly to the absence of some important food element.

"In some of the zoological gardens of Europe it is the custom to send roseate spoonbills and flamingoes to Amsterdam Garden to be recolored. The particular food by which Mr. Westermann accomplishes this end is a secret, but it is believed to be a kind of shrimp or small crustacean which has a quantity of red pigment in its shell."

In the same direction are the changes of color in other tissues by particular foods. It has long been known that when pigs are fed on madder their bones become red. This fact has been taken advantage of by physiologists in studying the structure and development of bone. The phosphate of lime acts on the coloring matter of madder as a mordant. When given intermittently to a growing animal, the bone presents alternate rings of red and white.

Darwin ("Origin of Species") mentions that pigs in Virginia eat the paint root (*Lachnanthes tinctoria*) and their bones are colored pink, and it causes the hoofs of all but the black varieties to drop off. "From facts collected by Heusinger it appears that white sheep and pigs are injured by certain plants, while dark-colored individuals escaped. . . . On asking some farmers in Virginia how it was that all their pigs were black, he was informed that the black members of a litter were selected for raising, as they only had a chance of living." Any one traveling through Virginia can verify this statement by noticing the preponderance of black pigs in that State.

Fleurens (1824) made use of madder for coloring the semicircular canals of pigeons to outline the canals more distinctly. (See also Ferrier on "Functions of the Brain," and the writings of Vulpin, the French physiologist.)

Mr. Lucas, osteologist of the National Museum, informs me that the bones of the crow are made purple by feeding on pokeberries. Ridgway says the bones of the Western fox squirrel are red, while those of its Eastern brother are white. No cause has been assigned for the difference.

See also experiments by Marci Paolini in 1141. ("Specimen quorundam experimentorum de vi Rubiæ ad ossa ovorumque Gallinarium putamina calcariæ colorandæ." No. 1 of "Miscellani Medichi," pamphlet vol. 1,149.) He gives a very good plate of the colored skeleton of a fowl, and also of its colored egg after four months' feeding *Rubia tinctorium.* He also gives references to other authorities, the most satisfactory of which is Belchior ("Philosophical Transactions," vol. ix., 1732), who gives an account of feeding hogs and fowls with madder root and wheat meal. A rooster so fed died in sixteen days, and showed the condition admirably. Other writers take up the subject after him in the same publication.

It is reported that among workers in cobalt and in-

* Read before the New York Academy of Medicine by invitation, April 5, 1893.—*Therapeutic Gazette.*

† Dr. William M. Gray, Army Medical Museum.

* Professor Robert Ridgway, Smithsonian Institution.

digo the hair becomes blue; also in artisans working with copper the hair takes a greenish hue.

The color of butterflies can be changed according to the food upon which the caterpillars are fed. More remarkable still, perhaps, is the change of color in the chameleon and in many insects, according to the color of the substance with which they are in contact.

The environment undoubtedly has a powerful influence upon the coloring of animals and birds. This is clearly illustrated in every museum of natural history. Specimens from arid desert regions are uniformly of a dull, faded appearance compared with those from regions of luxuriant foliage.

M. G. Pouchet ("Transactions of British Association for the Advancement of Science," 1872, p. 152), in his work entitled, "Mechanism of Change of Color in Fishes," says that it is due to the size of contractile color cells placed in the skin. These are under the influence of the nerves. The author found that the particular nerves controlling them (in the turbot) were nerves of the sympathetic system. By cutting the nerve supplying a particular area of the skin he had been able to retain that area unchanged in color, while the rest changed as the fish found itself on a dark or light surface.

That the eye is the means by which this change in its condition is communicated to the fish or crustacean, and that reflex action then takes place through the sympathetic nerves on the color-cells of the chromatophors, is proved by the fact that when the animal experimented on is blinded, no further change of color occurs when it is removed from light to dark, or the opposite.

See also the *Monthly Microscopical Journal*, 1871, vol. vi., M. G. Pouchet, on "Study of Connection of Nerves and Chromoblasts" (principally in fishes and batrachians).

The reasons assigned by naturalists for periodical change in color of plumage or fur are twofold:

1. Sexual selection.
2. As a protection against enemies.

1. *Sexual Selection.*—The male takes on a brighter and more attractive appearance to facilitate the business of courtship and the securing of a mate.

2. *As a Protection Against Enemies.*—In Arctic regions birds and mammals are usually white in winter, the color of the snow, so that they are with more difficulty found by their enemies.

Darwin supposes that originally only a few individuals took on this change, and these being better protected, gradually, by a process of natural selection, only the white variety was left.

It is apparent from what has been said that there is very much concerning the changes of color of the hair and other appendages of the skin in man and the lower animals that is not understood. In its normal condition the color of the hair is dependent upon the hair bulb.

It is here that the melanine is secreted from the coloring-matter of the blood, and from this point, as the hair grows, it permeates its cells, the intensity and shades, from black to blonde, depending principally upon the amount of the coloring-matter.

In black hair the hair-bulb is larger, contains a greater amount of melanine, and the hair itself is coarser and of more vigorous growth. In those cases where the hair has turned from white to black, and minute examination has been made, this has been found true.

In the case reported by Bruley, already referred to, of a woman, aged sixty, whose hair, previously white, became jet black four days before her death, the bulbs of the black hairs are described as being of immense size and engorged with dark pigment, while the roots of the white hairs that remained were dried up and two-thirds smaller in size.

So, on the other hand, in change from dark to white, the hair is finer in texture, less vigorous in growth, and the hair-bulbs smaller.

The sudden change in canities, when due to violent emotions, can be explained in no other way than through the bulb. It is true that there is no direct vascular or nerve connection between the bulb and its hair after it emerges from the skin; but it is also undoubtedly true that there is communication by osmosis between the cells of the papilla and those of the shaft and different layers of the hair.

Wilson ("Lecture on the Skin") ascribes the cause of sudden whitening of hair to insufficient nutritive power of the skin; also suggests that there may generate a gaseous fluid in the hair in place of its normal constituents.

He says, further, that the fluids from the blood vessels of the skin permeate the hair, and thus change in fluids may alter color.

In all of the cases of sudden change to white, where the hair has been examined, the coloring-matter has disappeared, and in its place is found an accumulation of minute air globules.

The same is true of gray hair of advancing age. How the air gets into the capillary structure has never been explained. Two possible explanations are offered:

One is that in the destruction of the coloring-matter a gaseous substance may be developed. This hypothesis has received no support from observation. The other is that air finds entrance from without through the sides or end of the hair.

It is possible to suppose a condition of the bulb producing a vacuum in the hair shaft that shall cause, by suction, a drawing in of air. This theory, which is proposed for the first time by the writer, I believe to be the true one, as explaining not only sudden canities, but also the gradual senile change to gray hair.

The view that the air finds entrance through the end of the hair is supported by the fact that the change of color begins at the extremity, and also by the observation that in all cases of change to white from dark hair the coloring-matter has been found to be replaced by air vesicles.

The *erector pili* muscle has an important influence on pathological changes which take place in the hair bulb.

This minute muscle has its origin in the true skin, and, passing downward, is inserted into the base of the hair bulb, so that when it contracts it lifts the hair outward and compresses its papilla.

The effect of sudden fright causes the hair to "stand on end" by contracting this muscle. Temperature has its influence with animals and birds. In cold weather (winter) the change is to white, in summer to black.

Cold, we know, contracts the skin, and thus probably causes pressure on the hair bulb. That the hair is easily influenced by external causes, as well as those which come through its bulb, is fully demonstrated. The mere fact that it can be so readily dyed and bleached artificially shows that the agents used for this purpose penetrate its substance.

Bleaching agents, such as chlorine, peroxide of hydrogen and strong alkalies, act by removing the coloring-matter and not by adding any *whiteness* of their own.

It remains to say a few words upon the subject of changing the color of the hair by substances taken internally, and as this paper has already exceeded the limit I had set for it, I shall be brief.

1. In the human subject the only agent, so far as I am aware, which has been charged with changing the color of the hair, when taken internally, is jaborandi. Of this sufficient has already been said.

2. Cayenne pepper in changing the color of canary birds to orange.

This is a well-known fact to bird fanciers. I tried in Washington to get a specimen to show you, but was told it was not the season for them—that they came in the autumn; also that they soon relapsed to their original color unless the cayenne pepper food was kept up.

3. The change of color in parrots by the Indians of the Amazon from green to yellow or red, by feeding the fat of a certain kind of fish (Wallace's "Amazon").

4. The restoration of certain birds to their original brilliant colors at the zoological garden, Amsterdam, by feeding a kind of shrimp or small crustacean.

5. As analogous to the above, the effect of madder in staining the bones of pigs red and of pokeberries coloring crows' bones purple.

It might be of interest, did time admit, to study the influence of diet and habit upon the color of hair in different nations of men, as, for instance, why the Saxons have light hair and the Gauls black hair.

It is within the bounds of possibility also that discoveries may be made in the future by which the color of the hair in the human race may be modified by judicious treatment of the parents.

Some colors of hair are not popular, especially with ladies, and it is not likely that cayenne pepper will ever become a favorite to produce the orange hue.

OF THE PLEASURES OF EATING, AND OF THE MEANS THAT MAY BE EMPLOYED FOR INCREASING THEM.*

WHAT has already been said upon this subject will, I flatter myself, be thought sufficient to show that for all the purposes of nourishment, a much smaller quantity of solid food will suffice than has hitherto been thought necessary; but there is another circumstance to be taken into account, and that is, the pleasure of eating, an enjoyment of which no person will consent to be deprived.

The pleasure enjoyed in eating depends, first, upon the agreeableness of the taste of the food, and secondly, upon its power to affect the palate. Now, there are many substances extremely cheap, by which very agreeable taste may be given to food, particularly when the basis or nutritive substance of the food is tasteless; and the effect of any kind of palatable solid food (of meat for instance) upon the organs of taste may be increased almost indefinitely, by reducing the size of the particles of such food, and causing it to act upon the palate by a larger surface. And if means be used to prevent its being swallowed too soon, which may be easily done by mixing with it some hard and tasteless substance, such as crumbs of bread rendered hard by toasting, or anything else of that kind by which a long mastication is rendered necessary, the enjoyment of eating may be greatly increased and prolonged.

The idea of occupying a person a great while and affording him much pleasure at the same time in eating a small quantity of food may perhaps appear ridiculous to some; but those who consider the matter attentively will perceive that is very important.

It is perhaps as much so as anything that can employ the attention of the philosopher.

The enjoyments which fall to the bulk of mankind are not so numerous as to render an attempt to increase them superfluous. And even in regard to those who have it in their power to gratify their appetites to the utmost extent of their wishes it is surely rendering them a very important service to show them how they may increase their pleasures without destroying their health.

If a glutton can be made to gormandize two hours upon two ounces of meat, it is certainly much better for him than to give himself an indigestion by eating two pounds in the same time.

I was led to meditate upon this subject by a mere accident. I had long been at a loss to understand how the Bavarian soldiers, who are uncommonly stout, strong, and healthy men, but who, in common with all other Germans, are remarkably fond of eating, could contrive to live upon the very small sums they expend for food; but a more careful examination of the economy of their tables cleared up the point, and let me into a secret which awakened all my curiosity. These soldiers, instead of being starved by their scanty allowance, as might have been expected, I found actually living in a most comfortable and even luxurious manner. I found that they had contrived not only to render their food savory and nourishing, but, what appeared to me still more extraordinary, had found out the means of increasing its action upon the organs of taste, so as actually to augment and even prolong to a most surprising degree the enjoyment of eating.

This accidental discovery made a deep impression on my mind, and gave a new turn to all my ideas on the subject of food.

It opened to me a new and very interesting field for investigation and experimental inquiry, of which I had never before had a distinct view; and thenceforward my diligence in making experiments, and in collecting information relative to the manner in which food is prepared in different countries, was redoubled.

* From an essay by Count Rumford.

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